Bicycle use in the Netherlands versus the United States

February 2004

Florine M.W. Bax

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Preface

This study is part of the NEURUS program, which stands for the Network for European and U.S. Regional and Urban Studies (NEURUS). The centerpiece of the program is the NEURUS Student Exchange. It gave me the opportunity to spend a semester abroad at the University of North Carolina at Chapel Hill. Here I did this study and I took a methodology course.

I hereby want to thank my personal advisor Dr. Asad J. Khattak. He really helped me in coordinating all my thoughts about the broad area: bicycle use in two different countries. It was really nice working with him. The person who helped me in showing the data sets, which are available in the United States, is Amanda C. Henley. Related to my study I also want to thank all the people who helped me in providing information about bicycle use in the selected cities. Randomly they are: Robert E. White, David Wessel, Jim Mitchell, Lee Shoemaker, Judith C. Wiegand, Meinrad Tabengwa, Al McGreehan, Dan Gaillet, Erik Solberg, Dick Minnema, Otto van den Berg, Elly Tanger, Hans Kombrink, and Peter Bootsma.

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I also want to thank my roommate Alicia Hairston who wants to read my paper before I will turn it in. I also want to thank Petra Pongracz and David Mau who are the other NEURUS students at UNC. We really made some wonderful trips together which helped me in exploring the surroundings of Chapel Hill. Another person I want to thank is Evelien Hermans. At times I didn’t have the motivation to do my study, she was the one who could motivate me again. The next person I want to thank is my boyfriend Rob Verver. At the moment I really missed the Netherlands I could phone him all the time. Besides this he also stimulated me in spending this semester abroad. Thereby he also helped me when I had computer problems.

And last but not least, I want to thank all the DCRP students who were very friendly to us and invited us at all the parties they organized. Because of this I really felt myself welcome at UNC. Besides this, I also want to thank the other people I met in Chapel Hill. Because of them I really enjoyed my semester.

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Abstract

The bicycle use in the Netherlands is relatively high compared to the bicycle use in the United States. This study is set up to clarify this difference and to give recommendations to increase the bicycle use in a city.

The hypothesis of this study is that the main factor, which affects the bicycle use in a city, is the bicycle policy of that city. This implies that the Dutch city Leiden should have the best bicycle plan.

To compare these two countries three Dutch and three American cities are selected. For each of these cities the bicycle plans are compared for four requirements. The first requirement is that a bicycle plan has to have enough diagnostic elements. Second of all, a bicycle plan has to have a clear strategy and related clear objectives. Besides this a bicycle plan also has to deal with the public support. Besides these requirements for a good bicycle plan, there also are some other factors that affect the bicycle use. Because of this, the selected cities are also compared for social, economic, spatial, weather, and competition factors.

The hypothesis of this study is proved, after all the cities are compared for their bicycle plans and potential causal factors for the bicycle use. The Dutch bicycle plan of the city of Leiden scores especially good for the diagnostic elements and the clear and relatively objective objectives. A recommendation is that cities use a traffic model to ascertain the need for bicycle supplies.

1. Introduction

The auto-dependency of Western societies has a lot of consequences. The extending use of unsustainable transportation modes results in a worse air quality. This air quality has again consequences for the public health. The oxides of nitrogen (NOx) for example, cause breathing problems and other health related problems, especially for younger and elderly people. Air quality is one of the major environmental and health concerns raised by unsustainable transportation choices (de Nazelle, 2001). Air pollution is thereby also damaging to vegetation, water quality, and visibility.

Because of these consequences of the use of unsustainable transportation modes, the purpose of this study is to understand the differences in the bicycle use. The bicycle is a sustainable transportation mode and will be compared for the Netherlands and the United States. These two countries, as apposed to other countries, will be compared because the researcher is familiar with the Netherlands. Besides this, the Netherlands is known as a bicycle country and the United States as an auto dependent country. These two countries differ greatly, despite the fact that the factors that affect the bicycle use, are similar for these two countries (Pucher, 1997). Besides the purpose to understand the differences in bicycle use, this study also has the challenge to give some suggestions to increase the use of the sustainable transportation mode. This is especially the case for the United States, were the use of unsustainable transportation is very high.

In the Netherlands, people ride their bicycle very often. In 2001 for example, 24.7% of all trips of people who are living in a 'very urban' area, were made by bicycle for all trip purposes (OVG, 2001). When you compare this to the bicycle use in the United States, the percentage is much lower. Only 0.7% of all trips, for all trip purposes, are made by bicycle by people, who are living in an urban area (NHTS, 2001). These percentages have not changed that much during the last decades. The bicycle use in the Netherlands is not only high compared to the United States, but also compared to other European countries. For example, in 1990 the percentage of trips made by bicycle in urban areas were 20% in Denmark, 10% in Germany, 8% in England and Wales, and only 5% in France and Italy (Pucher, 1997). There has to be an explanation for this enormous difference.

The actual bicycle use can be explained by its history. Unfortunately, there is no historical data available for the American bicycle use. During the twenties, the majority of people only had access to bicycles, so the government didn't think it was interesting to register how many people actually used their bicycles. When the auto was affordable for more households and became popular during the fifties and sixties, the American government didn't pay attention to bicycle use anymore. During the period automobiles became affordable for more people, all transportation plans are very focused on auto use (McClintock et al., 1992). The main reason for this is that policy makers had the belief that the auto is the future and therefore needs so much attention. The 'Autogerechten Stadt' is then a policy, which policy makers follow (de la Bruhèze and Veraart, 1999). As a result, the bicycle became a forgotten mode. Increasing auto use resulted in more dangerous situations for bicyclists. Autos crowded the roads more and more in the cities, so the space left for other transportation modes was decreasing. This resulted in more bicycle accidents and more fear of getting into an accident. Such fear resulted in a further decrease in bicycle use. This trend took place in both countries. Even though, the bicycle use in the Netherlands, stayed much higher compared to the bicycle use in the States. Since 1975, the Dutch government has encouraged the reemergence of bicycle use. This resulted in a small bicycle use increase, and for some places bicycle use stability. Fortunately the city governments in the United States are now giving more attention to the bicycle use as well. But compared to the Netherlands, the United States isn't that far yet. The focus to get people on the bike is also different from the Netherlands. American city governments still see the bicycle more as a healthy way to do exercises than as a serious transportation mode for commute trips. A proof that the federal (American) government is interested in the bike use is given by the Nationwide Personal Travel Survey (NPTS). In 1983, respondents had for the first time the possibility, to fill in the bicycle as an option for the transportation mode. These are the earliest reliable statistics about bicycle use in the United States (U.S. Dept. of Transportation, Bureau of Transportation Statistics, 2000).

Even though there is no historical data available for bike use in the United States during the 20th Century, the comparison in this study of the two countries is valid and very useful. The strength of this study is that it gives suggestions to increase the sustainable transportation mode, by learning from the experiences in the both countries. Contrary to other studies for so far, this study goes behind the point of just register the differences in bike use in the two countries; this study also provides suggestions to improve the sustainable transportation mode in both countries.

1.1. Structure of this paper

The next chapter of this paper contains the results of other studies that are important for this study. It also provides a summary table that contains the key findings of these studies and their methods. As a result of this literature review the hypothesis of the study is also clarified. Chapter 3 clarifies the used method of this study. You also find here the data, which are used. Chapter 4 is about the modal choice per country. The second part of this fourth chapter is about the selection of the six cities. Chapter 5 and chapter 6 contain the results of the study. In the fifth the bicycle policy plans are compared for four requirements. Chapter 6 deals with the other potential causal factors which affect the bicycle use. And, last but not least you find the conclusions and recommendations of this study in chapter 7.

2. Literature review

This part of the paper attempts to find the answer to the question why the bicycle use in diverse countries differ so much, by looking at the existing literature. The question thereby is what other researchers found as explanatory factors for the modal choice in general, and the bicycle use in particular. According to the literature there are six major factors which influence bicycle use. Per potential causal factor is analyzed what the diverse researchers say about it. At the end of this chapter there is a summary table about the key findings of these studies and their methods.

The fact that the traffic policy in a city influences the bicycle use is commonly accepted by transportation related researchers (de la Bruhèze and Veraart, 1999; Dieleman et al., 2002; Forester, 1994; McClintock et al., 1992; Pucher, 1997; Pucher, 1990; Pucher and Dijkstra, 2000; Pucher et al., 1999; Pucher and Kurth, 1995; Pucher and Lefèvre, 1996; van Werven, 1992; Wilkinson, 1997). However, the diverse group of researchers may find that the policy influences bicycle use in a different way. Forester (1994) for example has a unique way of categorizing city policy. He argues that you have two major ways of looking at bicyclists, based on the vehicular-cycling principle and the cyclist-inferiority superstition. The United States has followed the cyclist-inferiority superstition vision, for a long time. It's very hard to turn this into the other vision. The Channel Communications radio station, G105, proves that this vision is still alive under Americans. In a program at the 22nd and 23rd of September 2003, they promoted driving into cyclists as fun. Because fortunately, there were also a lot of negative reactions from the audience, the radio station decided to cancel this program. But overall, this example makes clear that the cyclist-inferiority vision still exists in the American society. Decades of popular acceptance of cyclist-inferiority programs have produced a negligible amount of cycling at an extremely high accident rate. Such programs have people driven away from cycling. The data support the principle that cyclists are successful when they act like drivers of vehicles, and society so treats them (also Pucher, 1997). Thereby the role for the city government is very strong. They should not support cyclist-inferiority policies, projects, and programs. What Pucher (1997) adds by this is that it's important for cities to stay alert by promoting bicycle use. Just building separate bicycle lanes is definitely not enough. In England and France for example, the bicycle modal split fell from (12% (1975) to 8% (1991)) and from (10% (1978) to 4% (1990)). The main reason for this is that the federal government in these countries has largely neglected bicycling as a practical mode of urban travel.

A second factor which influence the bicycle use in a city, are social factors. Social factors which are mentioned by Pucher and Dijkstra (2000) are for example the American culture and lifestyle (also Forester, 1994), the age distribution of the residents (also de la Bruhèze and Veraart, 1999; McClintock et al., 1992; Rodgers, 1994; Schwanen et al., 2001), and the real and perceived danger of cycling and walking in American cities (also

Wilkinson, 1997; Pucher, 1997; Pucher et al., 1999, and McClintock et al., 1992). Related to this are also the education young children get about traffic safety. Wilkinson (1997) even assumes that it's too unsafe to drive your bicycle in American cities, which results in the fact that children are prohibited from cycling by their parents. Pucher and Renne (2003) support this with data. According to their study the fatality rates per mile traveled as a pedestrian are 36 times higher than for occupants of autos and light trucks in the United States. When you compare these numbers with the Netherlands and Germany, pedestrian fatalities per mile walked are only a tenth as high as in the United States. The reason they give for this is the rigorous traffic education of motorists, and strict enforcement of traffic regulations protecting pedestrians in the Netherlands and Germany. Pucher (1997), Pucher et al. (1999), and van Werven (1992) emphasize more on the size of the student population. Their argument is that when the student population in a city is relatively large, the bicycle use is large as well because students can't afford a car. Besides this, students support the green environmental party more compared to the average population so the bicycle use will get supported even more. Besides this, Pucher (1997) also mentions that cyclists in the United States are often treated as second-class travelers. Dieleman et al. (2002) and Schwanen et al. (2001) mention the household composition according to the social factors. Especially when a household has children the bicycle use will drop. Pucher and Renne (2003) find more general factors like race and ethnicity, sex, age, and obesity rates, which they consider as social factors to influence the bicycle use.

A third factor which affect the bicycle use, are economically related factors (Dieleman et al., 2002; McClintock et al., 1992; Pucher and Renne, 2003; Schwanen et al., 2001). All these researchers mention the income factor as most important of the economic factors. The overall finding is that when income rises, the use of public transportation becomes less likely for shopping and, to al lesser extent, for work.

A fourth factor is the spatial factor. Overall there are four spatial related factors which are mentioned relatively often by different researchers. The first one is the form of the city, which includes the neighborhood design, and the density of the city. The idea is that a highly dense city supports cycling and walking (de la Bruhèze and Veraart, 1999; Cervero and Radish, 1996; Dieleman et al., 2002; Forester, 1994; McClintock et al., 1992; Pucher, 1997; Pucher et al., 1999; Pucher and Lefèvre, 1996; Pucher and Renne, 2003; Schwanen et al., 2001; Srinivasan, 2002; van Werven, 1992). McClintock et al. (1992) and Pucher (1997) also mention that the steepness of a city influence the bicycle use. The steeper a city is, the harder it is to cycle. The existence of a bicycle network related to other roads is also an important factor (Bergström and Magnusson, 2003; McClintock et al., 1992; Pucher and Dijkstra, 2000; Pucher et al., 1999; Pucher and Lefèvre, 1996; Wilkinson, 1997). It's very important for a bicyclist to have a safe road to cycling on. A last spatial related factor is the purpose of the trip. When you are planning for example to go to the grocery store to buy lots of products, a person decides earlier to take the auto instead of the bicycle. The transportation mode for a trip purpose is also very strong related to the personal characteristics (Dieleman et al., 2002; McClintock et al., 1992; Pucher and Dijkstra, 2000; Pucher et al., 1999; Pucher and Renne, 2003; Schwanen et al., 2001).

A fifth factor, which affects the bicycle use in a city, is weather related. Precipitation characteristics are especially influential when people are trying to decide to use their bicycles. (Bergström and Magnusson, 2003; McClintock et al., 1992). Related to this Bergström and Magnusson (2003) find that the condition of the road is very important for bicyclists. When the roads are very slippery because of the ice, it's very hard to drive your bicycle. When the government puts out salt or stones on the bike lanes as well, this is very positive for the bicycle use.

A sixth factor is the competition of other transportation modes. Having a good quality of public transportation can result in a lower bicycle use (Dieleman et al., 2002; Pucher, 1997; Pucher et al., 1999). But, not only the quality of public transportation affects the bicycle use, also the price of owing a car, the ease for obtaining for a driving license, and the gas price influence if people use their bicycle or not. Besides, when people are used to use their auto, it becomes very hard to get them out of that car again (Dieleman et al., 2002; McClintock et al., 1992; Pucher, 1990; Pucher and Dijkstra, 2000; Pucher et al., 1999; Pucher and Lefèvre, 1996; Schwanen et al., 2001; Wilkinson, 1997). Besides that, especially European studies like the one of de la Bruhèze and Veraart (1999) point out that the fact of having access to an auto or not also influence the bicycle use. The reason this is less mentioned in U.S. studies is probably related to the fact that it's much more common in the United States to have multiple autos in a household compared to European households.

As mentioned earlier, a summary table about the key findings of these studies and their methods is available on the next page.

2.1. Hypothesis

As a result of this review, the hypothesis of this paper is that the main factor, which affects the bicycle use in a city, is the bicycle policy of that city. As you can see in Table 1 the majority of the researchers mention this factor. The reason behind this hypothesis is that a lot of other potential causal factors are more or less dependent on this policy. Cities with a high bicycle use will probably also have good policy plans. In this plan is explained how to deal with the spatial environment and how to spend the money on the different transportation modes. A reason why this study is focused on local policy plans instead of national policy plans is because the most relevant decisions are made at the local level. National statistics on bicycle use in the Netherlands or the United States even, don't say that much. The differences on the local level differ too much for this. This results in the fact that comparing countries at a national level doesn't make sense because national bicycle use data are an average of the local bicycle use (de la Bruhèze and Veraart, 1999). So was the bicycle use in Kerkrade, in the south of the Netherlands, in 2001 only 7.9%, even though the national average was 24.7% for all trip purposes in the same year (OVG, 2001).

Table 1: Key findings of related studies and their methods

Author(s)	Year of publ.	Year of research	Source	Sample	Policy	Social	Economic	Spatial	Weather	Competition
Bergström and Magnusson	2003	1998-2000	Two questionnaire surveys for employers at four major companies in two Swedish cities, Luleå and Linköping, response rate 72% and 69%	433 people (1998) 1 company (2000)				x	x	
Pucher and Renne	2003	2001	NHTS (2001) and NPTS (1969, 1977, 1983, 1990 and 1995)	19,768 households		x	x	x		
Dieleman et al.	2002	1996	The Netherlands National Travel Survey (OVG)	> 150.000 people	x	x	x	x		x
Srinivasan	2002	1991	Daily activity data from the Central Transport Planning Staff (CTPS)	3,854 households				x		
Schwanen et al.	2001	1998	OVG	82,3% of 150,000		x	x	x		x
Pucher and Dijkstra	2000	1977- 1995	US, Dutch, and German Department of Transportation, the Nationwide Personal Transportation Survey (NPTS), and government documents and interviews with Dutch and German experts	3 countries (The Neth., Germany, and US)	x	x		x		x
de la Bruhèze and Veraart	1999	1998-1999	Historic sources from nine West European cities and transport policies of the diverse cities	9 cities	x	x		x		x
Pucher et al.	1999	1977-1998	US Department of Transportation (1994 and 1997), Insurance Institute for Highway Safety (1997), and US Bureau of Census (1998)	6 American cities and 1 Canadian	x	x	x	x	x	x
Pucher	1997	1997	Documents of German cities and Ministry of German Transportation	W-German cities	x	x		x		x
Wilkinson	1997	1950-1997	US Department of Transportation (1996)	The US as a whole	x	x		x		x
Cervero and Radisch	1996	1994	Two separate travel surveys (one for work trips, other non-work). Even though the response rate isn't high, it's comparable with 1990 census data.	840 HH (work) 620 HH (non-work)				x		
Pucher and Lefèvre	1996	1970- 1996	Transport Statistics from 6 European countries, Canada and the US.	8 countries	x			x		x
Pucher and Kurth	1995	1980- 1993	Ministries of transport and public transport of each individual country	14 countries	x					
Forester	1994	undated	Roadway design standards and traffic studies	US and Europe	x	x				
Rodgers	1994	1991	National survey of US bicycle riders	1,254 bicyclists		x				
McClintock	1992	1945-1992	Ministries of transport and policy plans	4 European countries and US	x	x	x	x	x	x
Werven, van	1992	1977- 1991	National Dutch policy and bike policy city of Groningen	City of Groningen	x	x		x		
Pucher	1990	1950-1987	Ministries of transport of each individual country	17 countries	x					x

3. Conceptual framework

3.1. Comparison of the bicycle plans

As the time for this study is limited, it's impossible to compare all existing city policy plans. Therefore this study analyses only six policy plans, three Dutch and three American ones. To decide which bicycle plans have to be compared, this study assumes that cities, which have a low portion of bicycle trips, have a low or bad developed plan or no plan at all. Finally you get a city with the highest bicycle trip portion, the less bike trip portion and a city with an average portion of bicycle trips per country.

Once the cities are selected, the bicycle and pedestrian plans have to be compared in a valid way. The way of doing this is according to the method used in the book 'Natural Hazard Mitigation, recasting disaster policy and planning' from Godschalk et al.. In this book Godschalk et al. (1999), use the following methodology to asses natural hazard mitigation plans. Godschalk et al. (1999) say that the first step is to establish requirements for a good plan. To asses these requirements, you have to have some measurable (smaller) requirements. After you assessed those (smaller) requirements, you can tell something about the overall assessment of the plans. The second step is to evaluate the plans with a three-part scoring system covering plan breath, quality, and a total of breath and quality. By what breath score stands for how frequently basic issues are addressed in the plans (scale 0-1). Quality score stands for how well a plan addresses each of its issues (scale 0-1). And finally, the total score is the sum of breath and quality scores (scale 0-2). Because this study only analyses six case studies, instead of all the bicycle plans, the approach will be a little different. The first step will be similar to the first step used by Godschalk et al.. But, the second step can't be similar because of the difference in the amount of plans that are compared. That's why the second step is to evaluate the plans by giving each factor an importance which results in a rank of quality of the bicycle plans. In chapter 5 you see the results of this last step.

There are four requirements for a good bike plan. In a nutshell a good bike plan has to have clear diagnostic elements, strategies, objectives, and has to take care of the public support (see Figure 1).

As far as diagnostic elements are concerned, it is very important for a good bike plan to characterize what's going on within the city before you are actually planning the future. When you don't know what your starting point is, it's impossible to know what your future will bring. Factors, which are useful, are for example safety numbers of bicyclists, safety numbers for the entire bike network, and characteristics of the bicyclists in the city like the age distribution. A useful method to improve the network is to identify unsafe points (black spots) in a network by looking at the safety statistics and later on to improve these points. But on the other hand it's also good to look a little bit broader than just the city. The residents of the city will not be the only ones who use the network.

Another requirement is that a bicycle plan has to have clear strategies. These strategies are dependent on the starting point, which can be cleared by using the diagnostic elements. These strategies have to be realistic and attainable. It doesn't make sense for an example to adopt an unrealistic strategy like: ‘In ten years 50 % of the residents have to use their bicycle for most of their trips’ (while at the moment this percent is only 10%).

Related to these strategies are the objectives the city sets up to reach their strategy. These have to be attainable and realistic as well. Related to this attainability is for example that there has to be enough money available to implement the projects to realize the objectives. Another important factor about these objectives is that they stay up-to-date. When a bike plan is out-of-date, it becomes useless. Linked with this is that a bike plan has to have a higher comprehensive plan which tells something about the overall strategies and objectives of the city. The bike plan has to be an operational plan.

A last requirement for a bike plan is related to the public support. It's not enough when the local government is the only one who supports the plan. It has to be supported by the residents as well. The reason behind this is that the residents are the ones who are using the bicycle facilities. When they don't support the bicycle plan at the crucial points, the time and money you put in the plan as a city government, is useless. It therefore is essential to inform the inhabitants during the planning process and, where useful, to ask them for their suggestions and opinions. When they give their opinions and suggestions on the plan, you have to discuss these suggestions. When the suggestions are useful, you should adopt them, when they aren't useful you have to give arguments why you think they aren't useful in this situation. Overall you have to handle suggestions from residents carefully. All these requirements will be discussed in chapter 5.

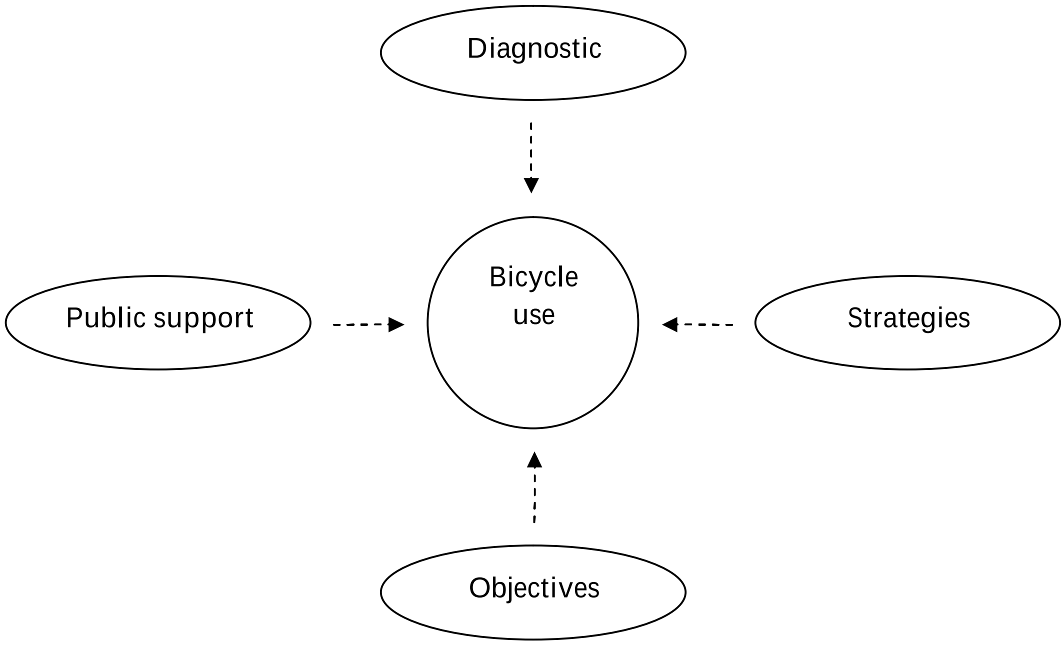

Figure 1: Requirements for a bicycle plan

3.2. Quantify the causal factors

Nevertheless, this study assumes that the existing bicycle plans of the six cities explain much of the differences between the cities. There are also other potential causal factors, which can explain the difference. As we have seen in the literature review part, five different potential causal factors are: social, economic, spatial, weather, and competition causal factors (see Figure 2). To compare these causal factors in a valid way, the causal factors have to be measured by as much un-dimensional measurements as possible. This is necessary because the countries really differ a lot as like the cities. When you use un-dimensional measurements, you partly skirt this problem.

For social factors this study looks at factors such as the population of the cities and the distribution of the age. Other social factors are culture differences between the two countries.

As far as economic characteristics concerns, the average income levels of cities are an important factor which influences the bicycle use. Per city these incomes are visualized.

Spatial causal factors can be measured by looking at the form of the city, which is more monocentric or polycentric oriented. Besides this, the average steepness of a city is also important. Another important spatial measurement is the existing bicycle network, compared to the other roads.

The weather characteristics are another important factor which influences the bicycle use. As is already mentioned in a Swedish study of Bergström and Magnusson (2003), especially the precipitation characteristics are important.

For the competition factor the numbers of autos, which are available per household, are useful. Per city these characteristics are visualized in chapter 6.

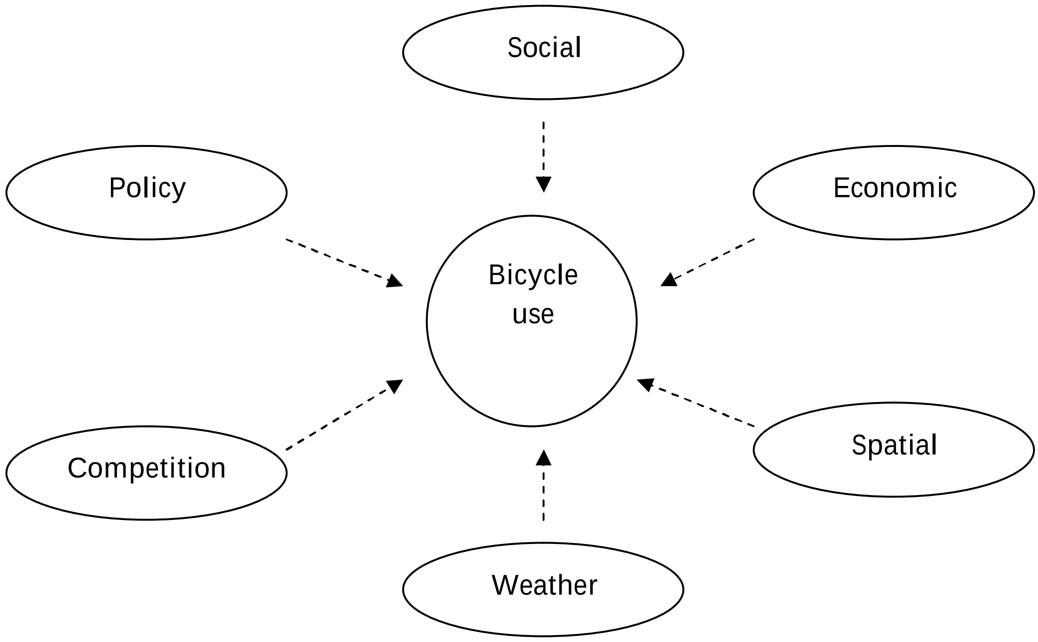

Figure 2: Factors which affect the bicycle use

3.3. Used data

The way to get these data is to use the National Household Travel Survey, NHTS (2001) for the United States. The NHTS, which is formerly known as the Nationwide Personal Transportation Survey (NPTS), and the American Travel Survey (ATS), are household-based travel surveys conducted every five years by the U.S. Department of Transportation. Survey data are collected from a sample of U.S. households and expanded to provide national estimates of trips and miles by travel mode, purpose, and a host of other characteristics. The survey collects information on daily, local trips and on long-distance travel in the United States.

Besides this, this study also uses the U.S. Census 2000 data. Every ten years this large study on a national scale is carried out. The first official Census backs even to 1790. Generally every decennial census is been conducted on April 1 in years ending in a zero. The Census data provide a basis for a lot of government related issues like the distribution of funds for government programs.

For the Netherlands there is a comparable transport survey available named as the ‘Onderzoek Verplaatsingsgedrag’, or OVG (2001). This survey is also conducted every five years. Besides this, there are yearly smaller questionnaires to compare the transportation flows by year. It’s, just like the American one, a national survey as well.

4. The Netherlands versus the United States

4.1. Modal choice in urban areas per country

Before selecting the six cities, it's useful to have an overall view of the modal choice in diverse urban areas for the two countries. This general view is given in this paragraph.

The Netherlands and the United States are in many ways different countries, but this doesn't mean it's not interesting to compare them. The Netherlands is known as a bicycle country and when you are looking at the modal choice of the two countries in Figure 3 and Figure 4, you see that this is supported by the data. The modal choice, or the distribution of the means of transportation, really is very different for the two countries.

By looking at the figures there are a few things that have to be clarified. The modal choices in these figures are for all trip purposes. So, the purposes going to work, study, a grocery store, and a recreational destination etcetera, are all combined. Besides this, the modal choice is for the households who are living in the specific urban categories. This doesn't mean that all the trips a household member makes are made in the city they live in. But, because the both countries use the same method, these statistics are comparable.

With the auto category, you have to take into account that these numbers are the percentage of trips people make by auto. This doesn't mean that almost 90%, in case of the United States, of all the trips is made by an automobile. The reason for this is that you also have a lot of people who are carpooling. This is especially the case for recreational trips (Schwanen et al., 2001).

Besides this you see that households, who are living in an area surrounded by urban areas, are using their bicycle much more often compared to the other American urban categories (2.5% instead of 0.7%). The reason behind this is statistical. In the category 'area surrounded by urban areas' are much less respondents compared to the other categories (only 0.1% of the total is in this category). So actually, this category is useless in the comparison, but because it's a defined category by the NHTS (2001), it's mentioned in this study.

When you look at the figures you see for example that the use of unsustainable transportation is much higher in the United States compared to the Netherlands. In the Netherlands driving your bicycle or walking to a destination is much more common and accepted. In the United States using public transportation is related to poor people who can't afford an automobile. You also can see that for the Netherlands it really makes a difference where you live related to the use of transportation mode. The denser the area you live in, the less you are using an automobile. Instead of using the automobile, people walk or use public transportation. In the United States the differences in modal choice don't differ that much for the diverse urban categories. In chapter 5 and 6 we will look closer at the factors behind the differences per city for the Netherlands and the United States.

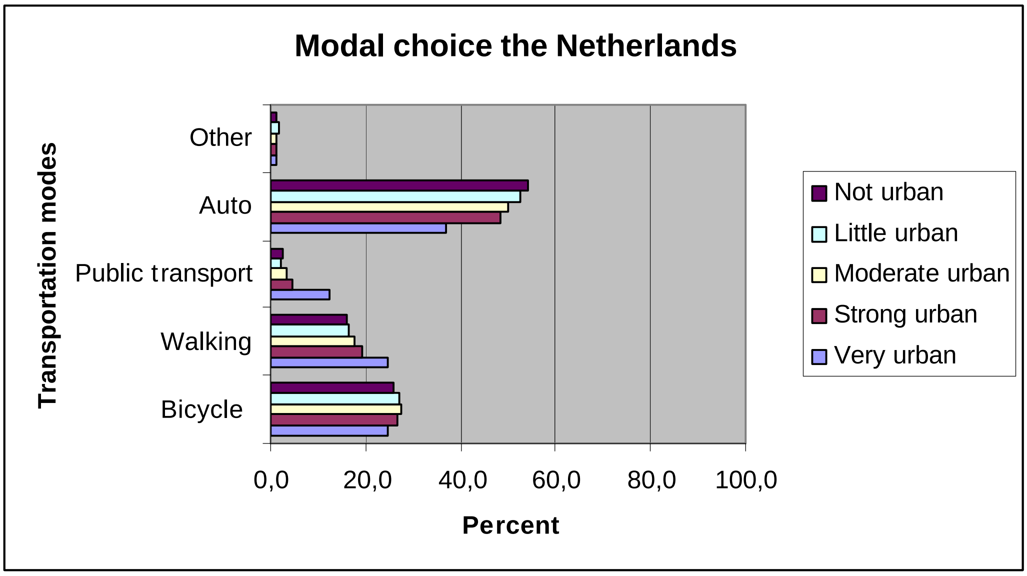

Figure 3: Modal choice in the Netherlands

Source: Authors calculations based on OVG (2001)

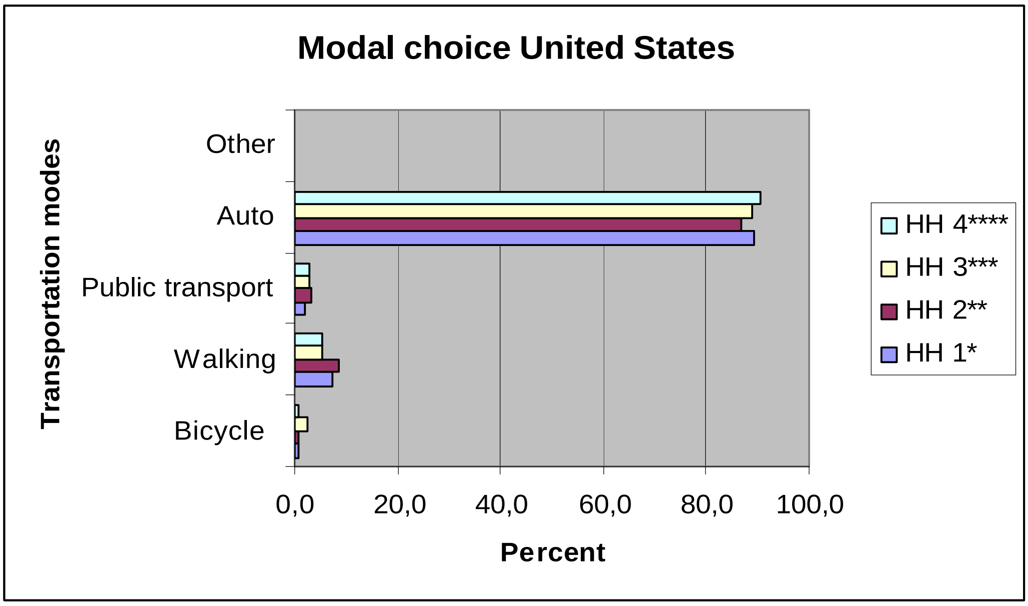

Figure 4: Modal choice in the United States

Source: Authors calculations based on NHTS (2001)

*: HH in urban cluster, **: HH in an urban area, ***: HH in an area surrounded by urban areas, ****: HH not in urban area

4.2. Modal choice per city

Now it is known how the modal choice for the diverse urban categories differs in the United States and the Netherlands, it's interesting to see how this modal choice differs for the diverse cities in the two countries. This really is necessary because, as already is mentioned; comparing countries at a national level for their bicycle use isn't that useful because national bicycle use data are an average of the local bicycle use (de la Bruhèze and Veraart, 1999). Besides this, bicycles are mostly used for the short trips until three miles, so are very local oriented.

In the Netherlands the category of a city is dependent on the amount of zip codes. When there are more then 2500 zip codes per square kilometer, a city is considered to be very urban (this is according to the definition the OVG uses). While this study is about bicycle use in urban areas, the focus for the Netherlands is on the category 'very urban' areas. For the sake of completeness you find in Appendix A the Dutch cities ranked on bicycle use for the nineteen-four 'moderate urban' cities, the fifty-five 'strong urban' cities, and the twelve 'very urban' cities in the year 2000. Again, these modal choices are for all trip purposes.

In the United States it's a little different. First of all, the data that are available from the National Household Travel Survey (2001) aren't useful for this particular information. The reason for this is that from 80% of the trips it's unknown in which city the trip was made because of confidential reason. This means that we have to use the Census 2000 data instead, which are less transportation specific. Here we are restricted to look at commute trips only and to the definitions the Census 2000 uses to describe urban areas. The definition Census 2000 uses to categorize an American city is a Consolidated Metropolitan Statistical Areas (CMSA) and a Metropolitan Statistical Area (MSA). These are both based on population. For the detailed definition, see Appendix C. The problem for this study with especially the CMSAs is that they mostly cover more than one state. These states aren't totally urbanized, so it is useless to compare them with European cities, like Dutch cities. MSAs cover mostly not more then one state, and are therefore more useful. This decision results in a list of the 280 MSAs and CMSAs in 2000 ordered for their bicycle use (Appendix B).

When you compare both lists you see that the difference in the city with the highest bicycle use and the city with the lowest bicycle use, for the same category, is much bigger for the Netherlands then for the United States. In Table 2 this is summarized. Besides this, you see that the difference for the CMSAs is really very small. This is another reason to focus on MSAs instead of CMSAs.

Table 2: Lowest and highest bicycle use for diverse urban categories

	Lowest bicycle use (%)	City	Highest bicycle use (%)	City
Moderate urban	7.9	Kerkrade	40.5	Wageningen
Strong urban	12.1	Brunssum	38.4	Zwolle
Very urban	16.4	Rotterdam	37.9	Leiden
MSA	0.03	Lynchburg (VA)	4.83	Corvallis (OR)
CSMA	0.12	Cincinnati and Hamilton (OH, KY, and IN)	1.36	Sacramento and Yolo (CA)

Source: Authors calculations based on OVG (2001) and Census 2000

Now the ranks of the cities for the two countries are common knowledge, the six case cities have to be selected. While the difference between Leiden and Rotterdam in bicycle use is 21%, the city, which is closest to 26.9% bicycle use, is Haarlem (with a bicycle use of 25.8% in 2000 for all trip purposes). In a similar way Flagstaff is the median city chosen for the United States. According to the statistics, it actually has to be Chico and Paradise in Florida. But, because these are two cities instead of one, Flagstaff is the city that will be picked out for the comparison.

When you look more closely at the MSAs, you see that a lot of their land is not urban related. That's why this study compares the defined places Corvallis, Flagstaff and Lynchburg. The reason this study looks at places instead of urbanized areas is that the boundaries of the places are given by the city governments instead by the Census bureau. We assume that the city governments can consider best which areas they define as their city and which areas not. The criteria they use are not purely based on the population density, but for example on zoning as well (Henley, 2003). For the detailed definition the Census bureau uses for urbanized areas and places see Appendix C.

4.3. Selecting the six cities

As the former paragraph already mentioned, selecting a case city isn't as easy as it seams to be. Besides this, in the United States the laws about having an up-to-date bicycle plan are not regulated by the federal government. The differences between states, and even between cities within the same state, can be enormous.

By the setup of this study is already taken into account that American cities don't even have a bicycle plan. Especially when the bicycle use isn't very high and city governments think that riding a bicycle isn't such a big issue. Of course this way of thinking itself influences the bicycle use again, because the facilities for riding your bike aren't optimal. But that's not the issue over here right now.

Firstly the web sites of the different cities are checked. But, in most cases, the existing bicycle plans are not available on the web sites. But, writing emails to the departments who are responsible for the transportation in the city is more successful.

Cities with a low bicycle use are relatively more contacted then cities with a high bicycle use, because the expectation is that cities with a low bicycle use have a bigger change for having no bicycle plan. This resulted in several emails to Corvallis OR, Flagstaff AZ, Florence AL, Gadsden AL, Jackson MS and Lynchburg VA. The responses varied from: 'Interesting research and you will receive our bicycle plan as soon as possible' to 'I'm sorry but I really can't give you our bicycle plan because it's too out-of-date' to 'We really think bicycles are important in our city, but at the moment we are in the period of setting up committees so I can't give you something useful right now'.

Lynchburg VA is the only city, of the cities with a very low bicycle use, which has something like a bicycle plan. In fact they don't have either a bicycle or pedestrian plan right now, but have just developed a comprehensive plan, which recommends that the city prepares and adopt a Transportation Master Plan (TMP). The TMP will address both bicycles and pedestrians in the city of Lynchburg. It is likely to be at least one year before this TMP is completed. But the region, which covers Lynchburg and the surrounding counties, does have a bike plan, which can be analyzed for this study.

The city of Florence Al, didn’t respond the emails at all, and Gadsen AL doesn’t have a plan at the moment. But, they are setting up committees to analyze what they have for so far. Jackson MS at last doesn’t have a bicycle plan either.

In the Netherlands the bicycle use is much higher and cities are forced by the federal government to have an up-to-date bicycle policy. In reality not all bicycle plans are up-to-date, but all the cities, which are contacted, could provide a bike plan for this study.

4.4. Bicycle plans of the six cities

Because the time period for a bicycle policy can vary per city, the documents of the cities with the most recent bicycle policy are used for the comparison.

For Leiden this results in a specific bike policy plan that is established in 1995 and is titled: 'Fietsers opstappen'. At the moment the city government is working on an update for this plan. For Haarlem there are two documents. The first one is the bike policy plan 'Haarlem Fietst', effective in September 1997 and the more overall plan 'Haarlems Verkeers- en Vervoerplan', which is more recent from December 2002. For Rotterdam the bike plan is not ready yet. That's why this study analyses the very recent overall plan for the city called: 'Verkeers- en Vervoerplan Rotterdam 2003-2020'.

Corvallis has a specific part for the bicycle policy in the overall plan. It became effective on September 1996. The city of Flagstaff has a Regional Land Use and Transportation Plan. In this plan the policy for the bikes can be found. The situation for the city of Lynchburg is already mentioned earlier in this paper. At the moment the city government is busy with creating a Transportation Master Plan, which will contain the bike policy. But in the comprehensive plan, which they just created, can be found the intentions for the Transportation Master Plan. Besides that, this study analyzes the plan that is established by the regional commission.

4.5. Location of the six cities

The six selected cities, in order from high to low bicycle use, are Corvallis (Oregon), Flagstaff (Arizona) and Lynchburg (Virginia) for the United States. For the Netherlands the selected cities are Leiden, Haarlem and Rotterdam. When you look at Figure 5 you see that the American cities aren't close together contrary to the selected Dutch cities. This is mostly because of the data. American cities were selected as close as possible to control for conditions like weather and mentality of the residents. Unfortunately the cities closest to Corvallis and Flagstaff, with a low bicycle use, don't have a useful bicycle plan. That's why Lynchburg is selected as the third American city.

Figure 5: Location six selected cities

Source: GIS Data UNC at Chapel Hill

5. Bicycle policy

As you can see in Figure 1, about the requirements for a bicycle plan, there are four factors, which will be compared for the six plans. Each factor will be discussed in a separate paragraph. For each factor there are smaller requirements for which the bike plans will be compared. To rank the bicycle plans, a four-point scale will be used, whereby 0 is the lowest and +++ the highest possibility. The table of the first requirement 'diagnostic' has an additional row 'total'. The number in this row represents the amount of +-en for this requirement.

In every paragraph the order of the discussed cities is similar. First the Dutch city with the highest bicycle use, Leiden, then with the moderate bicycle use, Haarlem and after all with the lowest bicycle use, Rotterdam. The order for the American cities is Corvallis OR, Flagstaff AZ, and Lynchburg VA. At the end of every paragraph there is a small conclusion per requirement.

5.1. Diagnostic

An important requirement for a good bicycle plan is that it has enough diagnostic elements of the city so the characteristics of the city are clear. It's a good thing when a bicycle plan mentions the modal choice for the specific city, preferable related to the modal choice of similar cities in the country.

Another interesting factor is the trip purpose when people are using their bicycle. When the majority of the bicyclists use their bike for commute trips, you want to have a direct network. But, when the majority only uses their bike for recreational trips, you want to have a bicycle network in a nice environment. Then the directness of the routes doesn't matter that much anymore.

Related to the trip purpose is the question which facilities are used by cyclists. Are they really using the bicycle racks, or prefer cyclists the bike racks at different places? And, which other bike facilities like bicycle lanes are used most?

But this is not the only important information for the diagnostic elements of a bicycle plan. Another factor, which can affect the bicycle use, is the distribution of age of the residents in a city. When you have a city where the average age of the inhabitants is very low, you can expect a higher bicycle use compared to a city where the average age is much higher.

But, not only the age of residents characterize a city. A bicycle plan also has to mention the bicycle network, which exists at the moment, including a map of these lanes. In this way it should be clear where the gaps in the network are located.

Related to the bike map it's interesting to know what are the unsafe points or sections in the network, known as the black spots. They can be useful because they can help by finding the reason behind collisions. But defining black spots isn’t very easy. You have to have a good database with all the registered collisions in a city. From each of this collision has to be available as much information as possible. This is very time and money consuming. But because it’s very effective and efficient to improve the network by handling the black spots, it’s definitely a useful method (Rotterdam, 2003). This study will check if the black spots in a bike network are defined.

Another safety related issue is the overall safety for bicyclists in a city. It's very useful to know how big the changes are in a city to get involved in an accident and how this is related to other comparable cities. Thereby it is also interesting to know what mostly the reasons behind the collisions are. How often is for example an auto involved in a collision with a bicyclists and who is mostly guilty?

Table 3: Requirement 'diagnostic' for bicycle plan

Cities	Leiden	Haarlem	Rotterdam	Corvallis	Flagstaff	Lynchburg
Modal choice	+++	0	0	++	+++	0
Trip purpose	+++	0	0	++	0	+
Bike facilities	+++	++	+	+	0	0
Age	+	0	0	N/A	+++	+++
Network	+++	+++	+	++	++	+
Black spots	+++	+++	+	+	0	0
Safety	++	++	+	++	0	+
Total	18	10	4	10	8	6

5.1.1. Leiden Diagnostic

When you look at Table 3 you see that the bike plan of Leiden scores good for the requirement modal choice. The modal choice is represented in a graph and is compared with other comparable cities in the Netherlands. For the year 1995, Leiden had already a high bike use compared to the other cities. Now we know that, six years later, the bike use in Leiden compared to other Dutch cities is the highest. Besides this, the plan also looks at the modal choice per trip purpose and the modal choice per distance traveled. There you see that the proportion of bike trips for distances till three miles is very high. But also for the distance proportion from three till five miles the bike is proportional more used than the auto in the city of Leiden. The bike plan mentions the existing bicycle park facilities in the inner city. At the moment this bike plan was written, there are three secure bike park facilities. One has a capacity of 600 places with 96,000 bicycles that are parked here in 1994. The other two have respectively a capacity of 225 and 650 places. In 1994 respectively 46,200 and 22,500 bicycles are parked here. All the three parking facilities have placed more bikes than the years before. The distribution of age of the residents is not explicitly discussed in the bike plan, but the plan does tell something about the amount of residents in Leiden. The bike plan provides several maps of the bicycle network. At one map for example the thickness of the lines, which represent the bicycle network, represent the amount of bicyclists on a working day. The black spots in the network are well defined. As soon as there is one registered collision, an intersection gets a dot. This dot is bigger as soon as there are more registered collisions. In this way it’s easy to see where the less safe spots for bicyclists are located. For the time period 1990-1993 Leiden is an unsafe city for bicyclists, especially when you compare the collision numbers with comparable cities. But, the city really works to improve this safety.

5.1.2. Haarlem Diagnostic

For Haarlem this picture is a little bit different. The bike plan for the city of Haarlem doesn’t score very well for the diagnostic elements. The plan doesn’t say anything about the characteristics of the cyclists at the moment. There is no information about the modal choice or related issues. But, the plan does say something about the bicycle racks which are available now and how they are used. The existing network with the defined black spots is available. Each dangerous intersection is described how the city wants to improve the existing situation. Also the safety of the bicyclist is an important factor in the bike plan. The plan isn’t very concrete about this aspect, but there is a data set available about the accidents in the city where cyclists are involved in.

5.1.3. Rotterdam Diagnostic

The overall plan of Rotterdam doesn't mention the first four ‘diagnostic factors’. The only information the plan provides related to the modal choice is the comparison of the auto and public transportation for their median travel time. The plan does provide a map, which represents the bicycle network in Rotterdam. But, at this map becomes clear that the network has a lot of gaps. The network isn’t very direct, which is very important when the bike is used for commuting. The plan does mention the black spots. Not specifically for the bicyclists, but for all traffic. The idea behind this is, is that the government wants to improve specifically these intersections to improve the overall safety. But related to this safety, the bike plan doesn’t provide collision or injure numbers of a traffic participant.

5.1.4. Corvallis Diagnostic

The bicycle plan of Corvallis contains information about the bike use in Corvallis, but doesn’t compare it to other modes of transportation. But, the plan does make a distinction between commute and recreational trips for bike trips. A bicycle facility like the bike lanes in Corvallis are less used then expected. The reason behind this is that a lot of these separate paths are not direct enough. This cost commuters a lot of extra time and therefore they use the more direct arterial and collector streets instead. As a result, the city government now focuses more on the directness of bike paths for cyclists, instead of separate bike lanes. The distribution of age of the residents is not available in the plan. But because the bike plan, which is compared for this analysis, is a section of a bigger plan, which is not available for this study, this aspect will not be analyzed for this city. The plan provides maps from the bike network in Corvallis. Thereby they make a distinction between four different types of bikeways; shared roadway, shoulder bikeway, bike lane, and multi-use path. Per category the plan says which category is preferable per situation. The black spots aren't clarified, but the government intents to start a bike collision data set. While this is not yet available, per project is analyzed what the problem points are. The plan doesn't really provide safety numbers of bicyclists, but the government definitely knows what they don't want to support like bicycles on sidewalks.

5.1.5. Flagstaff Diagnostic

The plan of Flagstaff provides good information about the modal choice. This plan even makes a distinction in modal choice for the summer and winter period. Besides this, the government also gives a potential modal choice for 2020, based on cities with similar circumstances. The diverse trip purposes for neither bike trips nor the bike facilities, which are used now, are mentioned in the plan. But, the plan gives a good description about the demographic characteristics for the city. For example the plan mentions that 'the population continues to be younger as a whole, compared to Arizona and the U.S. average, but that even though the population is aging' (city of Flagstaff). The plan also provides demographic projections for 2020. The plan provides two bicycle network maps. One map represents the bicycle network and one represents FUTS, which stands for Flagstaff Urban Trails System. The last one is more focused on recreational trips. The only thing this plan mentions about intersections is that: 'intersections often cause delays because the capacity of the roadway to deliver autos to the intersection significantly exceeds the capacity of the intersection itself. This phenomenon has caused some cities to adopt a 'narrow roads, wide nodes' approach where improvements to intersections like turn lanes and signal optimization, are favored over 'add-lanes' projects' (city of Flagstaff). The safety of the bicyclist is also not mentioned in the plan.

5.1.6. Lynchburg Diagnostic

The comprehensive plan of the city of Lynchburg only provides some information about the population characteristics, including future trends. The regional plan is the only plan, which provides some other information, even though it doesn't mention the modal choice in the city. The regional plan does provide some information about the characteristics of the bicyclists in the region. This regional plan says that the bicycle in Lynchburg is mostly used for recreational trips. That's why the region emphasizes more on a network for recreational purposes than on direct bicycle routes for commute trips. This factor can also be an explanation for the fact that Lynchburg is very low in the rank of bicycle use in Appendix B. The reason for this is that the ranking is based on the bicycle use in cities for commute trips instead of for all trip purposes. Unfortunately neither the bike plan, nor the NPTS (2001) provides information about the modal choice for this city for all trip purposes so this is the best available American ranking. The plan isn't clear about the bicycle facilities, which are used now. Regarding a map of the bike network, the plan rarely provides in this. It has a map of the existing bicycle network, whereby there are different maps with lanes for experienced and non-experienced cyclists. But, these maps are very unprofessional. Unfortunately there is no thought for black spots in the network or safety numbers of the cyclists. This doesn't mean there is no attention for safety at all; one goal of the regional plan is to improve the overall safety of the bicyclists.

5.1.7. Conclusions Diagnostic

Overall for the requirement diagnostic you see that the city with the highest bicycle use scores best for this requirement. When you compare the scores you see that Flagstaff and Lynchburg score best for the representing of age of the inhabitants. In fact this is the less interesting factor of this requirement. This namely is the only factor that you hardly can influence by (bicycle) policy. Another difference is that all the Dutch bike plans look at the black spots in a network, which isn't the case for the American plans. This is a good way to analyze, relatively objective, which (inter)sections of a network needs more attention. The safety aspect is related to this. Another interesting point is that overall the Dutch plans look better at the bicycle facilities that are used now. In fact this is not very surprising, because the Dutch cities do have much more bicycle facilities than the American cities. Even though, American cities have fewer bicycle racks, they still have to be in a good condition and at the right spot. Because, when they aren't at the right spot, cyclists won't use them.

5.2. Strategies

The main purpose of a bike plan is to reach the strategies of a city. Thereby the diagnostic elements of a city have to be the starting point. This is important because the strategy has to be realistic. When the existing modal choice for bicycles is only 2% at the moment, it's very unrealistic to support the strategy that this has to increase to 50% in the next ten years. A method to define a clear strategy is to use a traffic model. In this way it's easier to be less subjective then without using a model. Therefore this study will analyze if the cities use a traffic model or not to set up their strategies.

To measure if the strategy in a bike plan is realistic, first the strategies for the diverse cities will be summarized. After this summary, the strategies will be compared.

An important factor by the strategies is the money component. A plan can have very good strategies, but when there is not enough money available for the implementation, the projects that result from the bike plan can't be implemented. But at the other hand, a clear strategy is definitely necessary, even when there is no money available at that moment. The reason behind this is that when money becomes available, there has to be a plan to implement the diverse projects. This study will asses if the six plans mention available funds or not. And, if the plan makes a comparison about the amount of money available for the bike transportation facilities compared to the other transportation facilities.

Table 4: Requirement 'strategies' for bicycle plan

Cities	Leiden	Haarlem	Rotterdam	Corvallis	Flagstaff	Lynchburg
Traffic model	Yes	No	No	No	No	No
Clearness	+++	+++	+	++	+	++
Money	+++	0	0	+++	0	++

5.2.1. Leiden Strategies

The first question, according to the strategy component, is if the bike plan is based on a traffic model. For the city of Leiden this is the case. The bicycle plan contains a lot of maps created by this model. Besides this, the question is if the city has a clear strategy. The city of Leiden has three major strategies according to the bicycle use. The first one is that the amount of bike trips has to increase by 2% per year. This means that in 2010 the bicycle use is increased by 30% according to the year 1995. The second strategy is that in 2010 50% less people are injured while riding a bike. The last one is that the city wants 5% fewer bikes to be stolen each year. At first sight this might be too optimistic, but the city government is prepared to put a lot of money in bike projects. At the moment the bike plan is written, only fifty percent of the total budget needed to implement all the projects is covered. The government tries to combine as much projects with each other as possible for the uncovered projects. In this way you can get advantages of the economics of scale.

5.2.2. Haarlem Strategies

The strategies for the city of Haarlem aren’t directly based on a traffic model, but on other related policy plans. These other plans are developed for the country and the region. For each strategy is looked in what way these are useful for Haarlem. This results in four major strategies according the bicycle use in the city. The first three of these strategies are similar to the major strategies of the city of Leiden. For example, Leiden also wants the bicycle use to increase by 30%, that in 2010 50% less people are injured while riding a bike, and that fewer bikes get stolen in 2010. The fourth and last strategy is that in 1995 the bicycle policy has to be part of all the traffic plans of the city and city related regions. The bike plan doesn’t say anything about the money, which is available to improve the situation for cyclists. But this is related to the way this bike plan is set up. According to this policy plan, concrete projects will be thought out and implemented. That is the first time, according to the authors of the bike plan, that the money component is interesting.

5.2.3. Rotterdam Strategies

The bike plan of the city of Rotterdam isn't based on a traffic model. To own perception of the officials is decided what's best for the city. The strategy of the plan is very broad. A first strategy, which is traffic related, is that traffic has to be safer. But, the plan doesn't provide a target percentage. Another strategy important for the bicyclists is that the city wants to have less auto traffic in their own neighborhoods. Because the plan doesn't provide percentages, the strategy is not very clear. The money component isn't mentioned either.

5.2.4. Corvallis Strategies

Also the bike plan of Corvallis isn't based on a traffic model. But, fortunately the strategy for the city is pretty clear. The government wants to create an environment which provides 'safely, conveniently, and pleasurably cycle from the home to all destinations within Corvallis' (city of Corvallis, 1996). Therefore they want to improve the bike safety on arterial and collector streets. Unfortunately there is no target percentage of bicycle increase, which makes the strategy less clear. The plan does provide information about the source of money to implement bicycle projects. For example there exists a City Street Fund. The plan doesn't provide information about the fact if the money that is available, is enough to implement all the projects, but per project is indicated how high the costs are for implementation.

5.2.5. Flagstaff Strategies

The bike plan of the city of Flagstaff isn't based on a traffic model either. In the transportation section there are four major strategies whereby three of them are also focused on the bicycle policy. Overall, the strategies are pretty broad and vague. The first strategy is that the city wants to create a safe, convenient, and user-friendly transportation system. Another strategy is to support a diverse range of transportation choices, including transit, walking and bicycling, as well as driving. The last one is that the Region's transportation system will be developed and managed with attention both to supply-side (e.g. new roads) and to demand-side strategies. The plan doesn't speak about the costs for the implementation.

5.2.6. Lynchburg Strategies

The regional plan is the only bike plan for Lynchburg, which can be analyzed for this requirement. The reason behind this is that the only strategy of the comprehensive plan of the city is to create a new bike plan for the city. The regional plan isn't based on a traffic model. But, the plan has five very specific goals. So is one strategy to provide the citizens with a first-class bikeway system, which meets the needs of the users, which is the second strategy. Another strategy is to promote tourism. The fourth one is to ensure that the existing and future bikeways provide safe alternatives to motorized transportation. And finally the plan also wants to increase the bicycle safety. The plan doesn't provide a definite answer about the money that is available for the implementation of the plans. But, there is a table that gives the cost estimates for the specific adaptations of the existing situation.

5.2.7. Conclusions Strategies

Because each bike plan is written for a different city with specific circumstances, it's very hard to compare the strategies of the diverse plans. However, you can look at whether the bike plan strategy is clear enough for specific situations. Except for Haarlem and Flagstaff this is the case, but it's not very obvious when you look at Table 4. A big difference between the six plans is the fact that the bike plan for the city of Leiden is the only one that is based on a traffic model. It really helps a city to make more objective decisions about the strategies for the bicycle policy. The bike plans of Haarlem and Rotterdam are indirectly based on a traffic model. This is because the overall plans, on which the bike plans are based, use a traffic model to establish the strategy. The American cities don't use a traffic model at all. The reason the money component is not always available in the plans has to do with the set up of the diverse plans. Some cities like Haarlem, Rotterdam, and Flagstaff use the analyzed plan more for the overall strategies. As soon as a traffic situation has to change, a special implementation plan has to be written for this specific traffic adaptation. In this implementation plan the money component becomes interesting.

5.3. Objectives

Following to the strategy, a bike plan has to provide objectives to concrete their strategy. As the strategy, the objectives have to be clear as well. They have to be realistic and attainable. To measure if this is the case for these six bicycle plans, per city is summarized what the objectives are.

This study analyses for all these objectives if they connect with the strategy and how they are related to each other.

Because the bicycle situation of a city can change enormously within a period of time, it's very important that the objectives of a plan are up-to-date. Therefore this study finds out when the existing bicycle plan became effective. And related to this, what the planning horizon for the plan is. It really makes a difference when a government creates a plan for five years or for over thirty years. You have to see this difference in planning horizon back in the specifics of the objectives. The shorter the planning horizon is, the concreter the objectives have to be.

Correlated to this is the question at what time the bicycle plan, before the existing one, became effective. When the period between the two plans is too long, it's not a good sign.

Another requirement related to the objectives, is that a bicycle plan has to be comprehensive with other city plans. The bike plan has to be operational, and be in line with the overall plan. For this study this results in the question if there exist such an overall plan. But, because in some cities the overall plan is the only 'bicycle' plan which exists, the question is also if there exists an operational plan especially for bicycles.

Table 5: Requirement 'objectives' for bicycle plan

Cities	Leiden	Haarlem	Rotterdam	Corvallis	Flagstaff	Lynchburg
Clearness	+++	+++	+	++	+	++
Connection	+++	+++	+	++	+++	++
Date realization / effective	Dec 1995	Sept 1997	Sept 2003	Sept 1996	2001[1]	Sept 2002,[2] 2004, and May 2000
Planning horizon	15 years	15 years	15-20 years	20 years and 30-50 years	20 years	20 years
Former (bike) plan	1978	[3]	1993[4]	1983	[5]	1984[6]
Other plans	++	++	++	++	++	0

5.3.1. Leiden Objectives

The plan of the city of Leiden is pretty clear about the objectives for the city. These objectives are also definitely connected with the overall strategy. For example to encourage people to ride their bike, the bikes will get priority at the traffic lights where possible. This results in less travel time for bicyclists. When you look at the realization date of the bicycle plan for the city of Leiden, you see that it's rather old. It's already workable since December 1995. The intentional planning horizon was fifteen years, but because in the last ten years so much changed already, the government is renewing the plan at the moment this study is carried out. The former bicycle plan for Leiden backs to 1978. According to the comprehensive component, the plan scores also well. In a very detailed way is explained how it has to connect with the other plans for the city.

5.3.2. Haarlem Objectives

The objectives for the city of Haarlem are well described. For example to realize that fewer bikes get stolen, more bicycle racks will be placed to lock your bike on. Besides

1 : 2001 is the draft version
2 : September 2002 is the implementation date for the comprehensive plan, in 2004 the TIP will be implemented, and since May 18, 2000 the Regional Bicycle Plan is effective
3 : This is the first bicycle plan for the city of Haarlem
4 : 1993 is the implementation date from the former overall plan
5 : This is the first time the overall plan has a transportation part
6 : 1984 is the base for both the comprehensive plan and the TIP

this, the government wants to count the parked bikes so there is a picture how often the racks are used. The bike plan of Haarlem dates back to 1997. It's workable until 2010. This is possible because of the set up of the plan. It's, compared to the bike plan of Leiden, a more strategic plan. The bicycle policy plan is also well connected with other plans, while this is the last major strategy.

5.3.3. Rotterdam Objectives

The objectives for Rotterdam are very vague, just like its strategy. To realize the safety strategy for example, the city is divided in 'city living areas' ('stadsleefgebieden'). The roads, which aren't in these areas, have to accept all the traffic that isn't going trough these areas anymore. Besides this objective, the plan also wants to build more bicycle racks. Because the strategy is already vague, it's very hard to determine if the objectives are related to the strategy. The overall plan is just renewed and backs to September 2003. The plan before this overall plan is ten years old now, even though the planning horizon for that plan was 15-20 years as well. Also here the case of enormous changes over time is the reason behind this early renewing. The plan does mention other plans, which are connected with the one that is analyzed for this study.

5.3.4. Corvallis Objectives

One general objective for Corvallis is to improve the bike network for commute trips by making it more direct. This results in creating bike lanes on existing streets instead of separate bicycle lanes. Another objective is to implement all the projects, which range from an existing improvement to a totally new bicycle facility. A scale system ranks all these projects. This scale system contains a tier priority scale, a safety, enhancement, link scale, and a numerical priority scale. The existing bike plan is workable since September 1996 with a planning horizon of 20 years. In this city the bicycle situation is apparently not changed more than expected like it is the case in the Dutch cities Leiden and Rotterdam. The government takes the view that the existing bike plan is still recent enough. In June 1990 a Trails Master Plan is conducted. This plan addresses important issues relating to a trails network and bikes but does not address other important bike issues related to the bicycle as a transportation vehicle. That's why the existing bike plan is created which is much more specific for bicycles. According to the comprehensiveness, there exists also the Corvallis Motorized Vehicle Street Traffic and Circulation Plan. The bike plan is well connected with this one.

5.3.5. Flagstaff Objectives

The city of Flagstaff has four major strategies. Per strategy they formed several objectives to realize the strategy. A positive thing about these objectives is that there is also a time frame connected to these objectives. Flagstaff has a comprehensive plan with a transportation part about the policy for this particular study field. For an implementation plan it's rather too general, but the time frame makes it a little bit more concrete. While the bike policy is visualized in the comprehensive plan, this policy is well connected with the overall policy.

5.3.6. Lynchburg Objectives

The regional plan is clear about the objectives to realize the strategy. To develop a system of bikeways that meets the needs for the users the objective is for example to facilitate the selection of routes that will enable localities to pursue public and private funding sources to complete the system. Because per strategy is written how to realize it, the connection between the strategy and the objectives is very strong. For Lynchburg there are three plans that have to be taken into account. These are the comprehensive plan, the Transportation Improvement Plan (TIP), and the regional plan. The comprehensive plan is effective from September 2002, but the TIP will only be effective in 2004. As soon as the TIP is effective, the bike policy for Lynchburg is up-to-date again. While the TIP is based on the comprehensive plan the plans will be well connected.

5.3.7. Conclusions Objectives

Overall you see that the planning horizon is longer for the selected American cities compared to the Dutch cities. Thereby the official planning horizon for the Dutch cities Leiden and Rotterdam is fifteen years, but the cities are renewing the bicycle plans already. The reason for this is that apparently the traffic situation in the cities changed in a different way than originally was expected. Another interesting point is the fact that the regional plan where the city of Lynchburg is part of, is bad connected with the other existing plans. This is partly because the author of the regional plan is not part of the city government. When you look at Table 5 you see that the other cities have a similar rank for the ‘connection with other plans’. This doesn’t mean that all the bike plans are well connected with the overall plans. The only thing you can be sure of is the fact that on paper the diverse plans are well connected. To be sure this is also the case in reality, you should have insight in all the other connected plans. But, as the time of this study is limited, this is not possible.

5.4. Public support

Public support is not specifically important for bicycle plans, but for all government plans. When residents totally don’t support the city bike plan, it will be very difficult to convince them that this is the right direction the city is going to. But at the other hand you have to keep in mind that residents are mostly not used to think about creating a bike plan. They aren’t professionals. So it’s very important to find the right balance between informing the residents and involving them at the creating of a plan.

Thereby a city government has to be very clear about the influence residents having at a session where there is an opportunity for public comment. Because, when the plan is already totally set up and just for mandatory reasons such a session is set up, it doesn’t make sense. Then it is definitely better to give an information meeting instead of a meeting where residents have the opportunity for (fake) public comment. It’s fake because the intention of the government is not to get participation of the residents but just informing them.

Knowing all this, a bike plan should be clear about its intentions by involving the residents. For this study useful questions are if the residents are informed or had the opportunity for public comment before the bicycle plan is implemented. And related to this, if they had the opportunity during these meetings to give their suggestions or not. A next question is what the city government does with the suggestions from the inhabitants. Do they actually change the planning concept or are they only consuming all the suggestions and hopefully thinking of it the next time? Also important is the time the sessions open for residents are held. When they are for example only during working hours, it's very hard for working people to attend these sessions. It should be much better when these sessions are during the evenings when most of the residents don't have job restrictions.

Table 6: Requirement 'public support' for bicycle plan

Cities	Leiden	Haarlem	Rotterdam	Corvallis	Flagstaff	Lynchburg
Informed?	+++	+++	+++	+++	+++	+++
Suggestions	+++	+++	+++	+++	+++	+++
Time	+++	+++	+++	+++	+++	+++

5.4.1. Dutch cities Public support

The Dutch national law requires that residents have the possibility to give their suggestions to a plan that is established by the government. That's why this paper deals with the requirement public support per country instead of per city. As soon as a Dutch city government wants to change their policy, they have to make a public announcement about this. As soon as the draft version is ready, residents have the possibility to read this plan and to give some critiques at it. During this time there are also several evenings where the draft version will be discussed in public. To all the reactions given by the residents, the government has to give a written reaction in a special document next to the draft version. As soon as all the reactions are conducted, the city is ready to write the final bicycle plan. This plan will be implemented.

5.4.2. American cities Public support

In the United States it's dependent on the city government if the residents have the possibility to give their suggestions. For these three cities, this is the case. For example commissions are formed in Corvallis, which are filled with residents on voluntary basis. And in Flagstaff the core planning team, which established the plan for Flagstaff, worked with a 28-member Regional Task Force consisting of city and county residents. The Task Force gave input about what was going on in the community. Besides this, there were also several open houses, where interested people could go and give suggestions. And the draft version of the comprehensive plan of Lynchburg was available on the internet. Residents could give their opinion in this way about the plan.

5.4.3. Conclusions Public support

Overall this requirement is very hard measurable. To have a better view about the real influence residents have, you should question a lot of residents. Unfortunately this time isn't available in this limited study. That's why in Table 6 all the bike plans are measured equal. The reason it's mentioned in this study is that an important aspect of a good bicycle plan is to pay attention to the public support of a plan.

As we looked now at the specific bicycle policy plans of the diverse cities, the next step is to compare the six cities on other aspects. These other aspects are causal factors, which can't be influenced by the officials of a city (Figure 2). This comparison is the content of the next chapter.

6. Potential causal factors for bicycle use

This chapter discusses the potential causal factors per city. The potential causal factors, which are analyzed in this chapter, are visualized in Figure 2.

But before this, Figure 6 gives an overall picture of the modal choice in the six cities. Unfortunately for the Netherlands the modal choice per city for commute trips is not available. At the other hand, the modal choice for the three American cities for all trip purposes is not available either. That's why the Dutch category 'very urban' is also added. This category represents in Figure 6 the distribution of the transportation modes for commute trips in the Netherlands. In this figure you clearly see that the auto in American cities is used instead of the bicycle in the Dutch cities. Besides this the amount of walking trips are similar for respectively the three Dutch and three American cities.

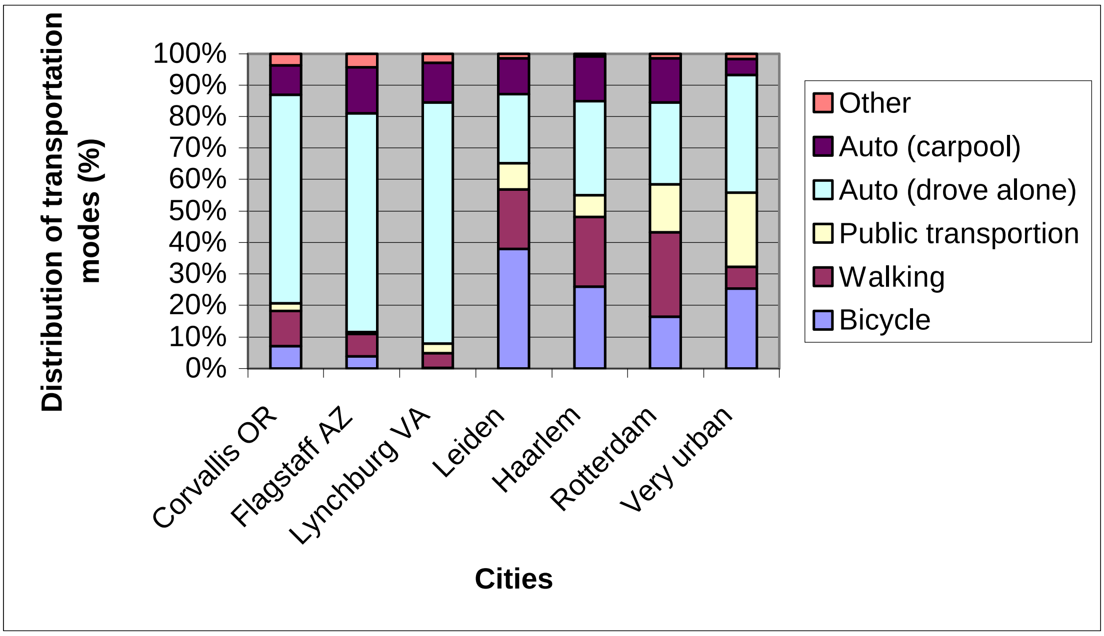

Figure 6: Modal choice for the six selected cities

Source: Authors calculations based on Census 2000 and CBS (2000)

6.1. Social

A social causal factor is the population of the city. When you only look at the amount of residents, you see that in all the selected American cities, less people live compared to the Dutch cities (Table 9). But, for both countries the selected cities are normal urbanized cities, so that's why it's valid to compare these six cities. Related to the bicycle use it's interesting to know how the age distribution of the residents looks alike. Therefore Figure 7 is established.

In Figure 7 you see that Corvallis has a relatively young population. This is partly because of the big Oregon State University (OSU), which is situated here. In a lesser extent this is also the case for Flagstaff, which has the Northern Arizona University (NAU). As soon as you compare the diverse Dutch cities, the difference in age distribution is much smaller between the cities. Even though, Rotterdam (Erasmus University Rotterdam, EUR), and Leiden (Leiden University) do have a university, and Haarlem has not.

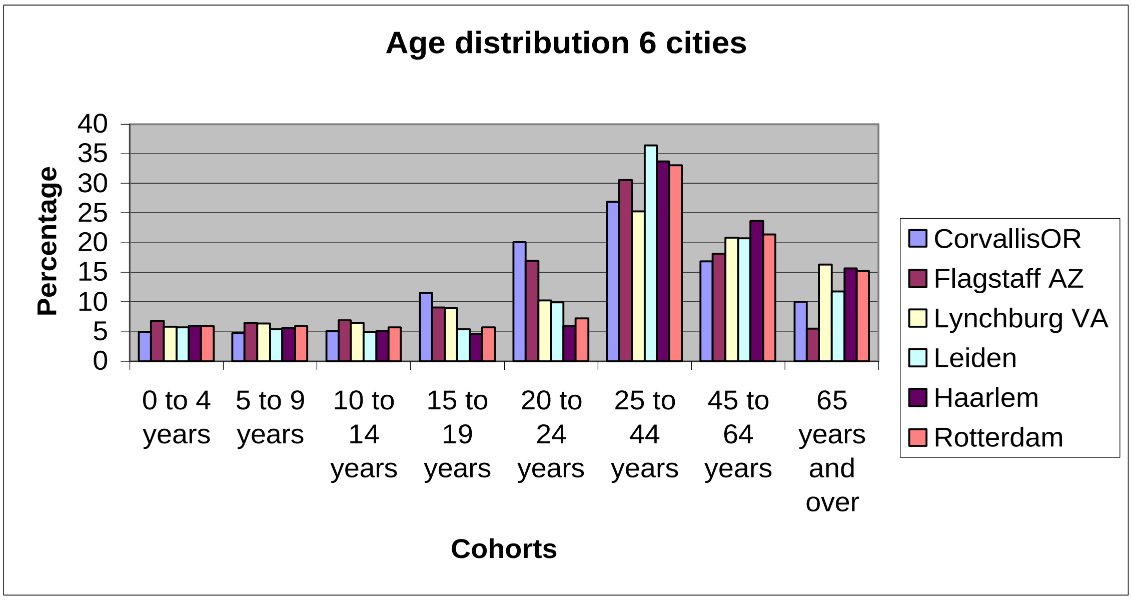

Figure 7: Age distribution for the six selected cities

Source: Authors calculations based on Census 2000 and CBS (2000)

Another related social causal factor is the culture difference between the two countries. A nice example that American citizens are very auto oriented is given by a sentence from the bike plan of Corvallis. By the explanation why it's very important to plead for bicycle racks the bike plan connect the feeling of automobilists with bicyclists. In the bike plan of Corvallis is written (1996): 'Bicycle use, particularly commuter use, is greatly influenced by availability of bicycle parking. Bicyclists need safe, well-lighted, dry, and convenient storage for their bicycles after arriving at their destination. Automobile drivers can imagine avoiding places where they had to park a convertible with the top down and the keys in the ignition, out in the rain and an inconvenient distance away from their destination. This is how bicyclists feel when they must park in inconvenient places, often with nothing secure to lock their bikes to, making their bikes easy prey for thieves.'

Another culture difference is that using public transportation or a bicycle is related to poor people in America. McClintock et al. (1992) mention in relation to this that at least until recently very few adult cyclists would dream of being seen riding a bike on their daily journeys. A possibility to change this situation is to encourage well-known people to cycle regularly.

6.2. Economic

Another factor, which influences the bicycle use, is the income of a household. A big portion of poor households can be an indicator for high bicycle use because those households can't afford an automobile. At the other hand, as soon as the income is proportionally higher, you can expect a low bicycle use.

For both the countries the average income distribution characteristics are visualized in Figure 8 and Figure 9. As can be seen, the cohorts for the incomes are different for the both countries. For the Netherlands the average distribution of the national income is ten percent for each cohort. In this way you can easily see in what way the income distribution of the specific city differs from the national average. Besides the different distribution of the cohorts, the range of the income cohorts is different. This is partly because of the median household income difference per country. In this case the median household income for the American cities is much higher compared to the Dutch cities (Table 7 and Table 8).

Table 7: Dutch median household income 2000

Dutch median household income (Euro)	
Leiden	24,700
Haarlem	25,100
Rotterdam	21,800

Source: CBS (2000)

Table 8: American median household income 2000

American median household income (Dollar)	
Corvallis OR	35,236
Flagstaff AZ	37,164
Lynchburg VA	32,234

Source: Census 2000

The reason the lowest cohort in the cities Leiden en Rotterdam is relatively high, is probably because of all the students who are living in these cities. Officially they are a single household and have in general an income below the national average. Corvallis and Lynchburg are the two cities that are below average in relation to Flagstaff. But overall the income distribution of the three cities is similar. The conclusion is that you can't really see a direct link between the bicycle use related to the average income in these six selected cities.

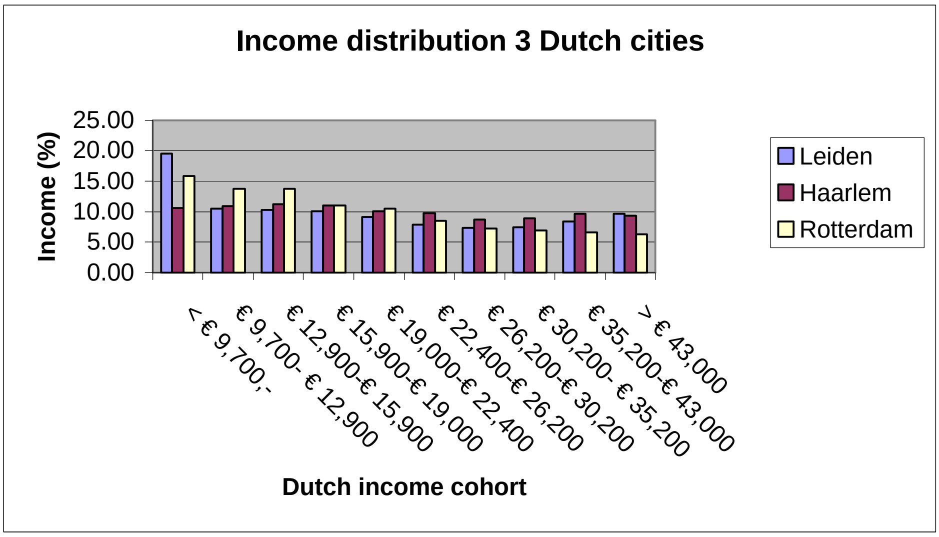

Figure 8: Income distribution Dutch cities

Source: Authors calculations based on CBS (2000)

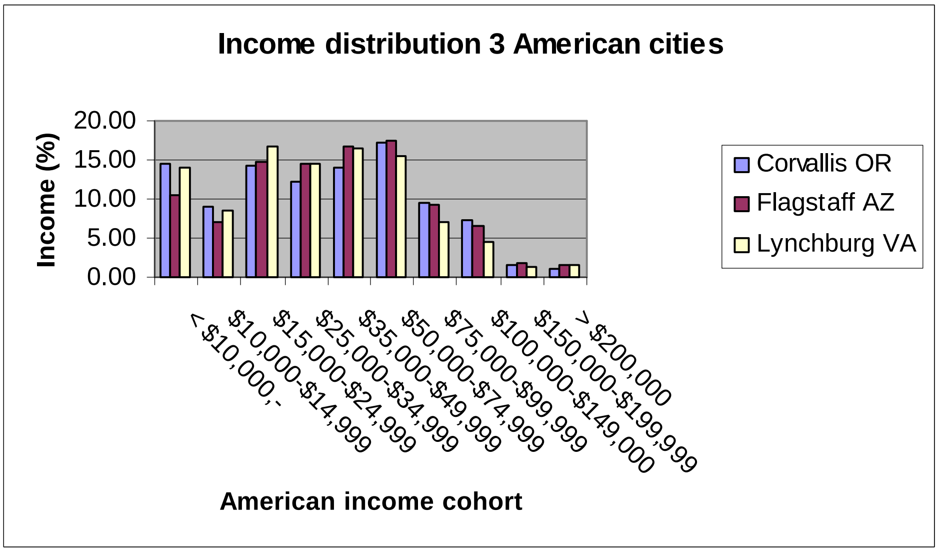

Figure 9: Income distribution American cities

Source: Authors calculations based on Census for the year 1999

6.3. Spatial

Another factor, which affects the bicycle use, is spatially related. When the locations are closer together, it’s more expected that people use their bicycle instead of the auto.

In Table 9 you find a summary table about the six cities and their amount of residents, their surface area and, related to this, the residents per square kilometer. In this table you immediately see that the density of the Dutch cities is much higher compared to the

American cities. For both countries you see that the city with the highest national bicycle use, has the highest density of the selected cities for that country. Related to this you can say that there exists a relationship between the density and the bicycle use for the selected cities. But at the other hand, the density of the third American city is higher then the second city.

Table 9: Density six cities

	Leiden	Haarlem	Rotterdam	Corvallis	Flagstaff	Lynchburg
# Residents	117,191	148,484	592,673	49,322	52,894	65,269
Surface area (sq. km)	22	29	209	35	165	128
# Residents per sq. km	5288	5042	2841	1394	320	508

Source: Author's calculations based on CBS (2000) and Census 2000

Because it's more interesting for people to know their travel time to work instead of the distance, Figure 10 is established for this study. Unfortunately, this information is not available for the Dutch selected cities. The only Dutch information available about the travel time to work is the mean travel time to work per city, which is available in Table 10. As you look at Figure 10 you see that Lynchburg in the category until fifteen minutes, has a lower portion compared to the other American cities. This probably is because of the fact that Lynchburg isn't situated near an interstate highway, so the time to go to another city is longer.

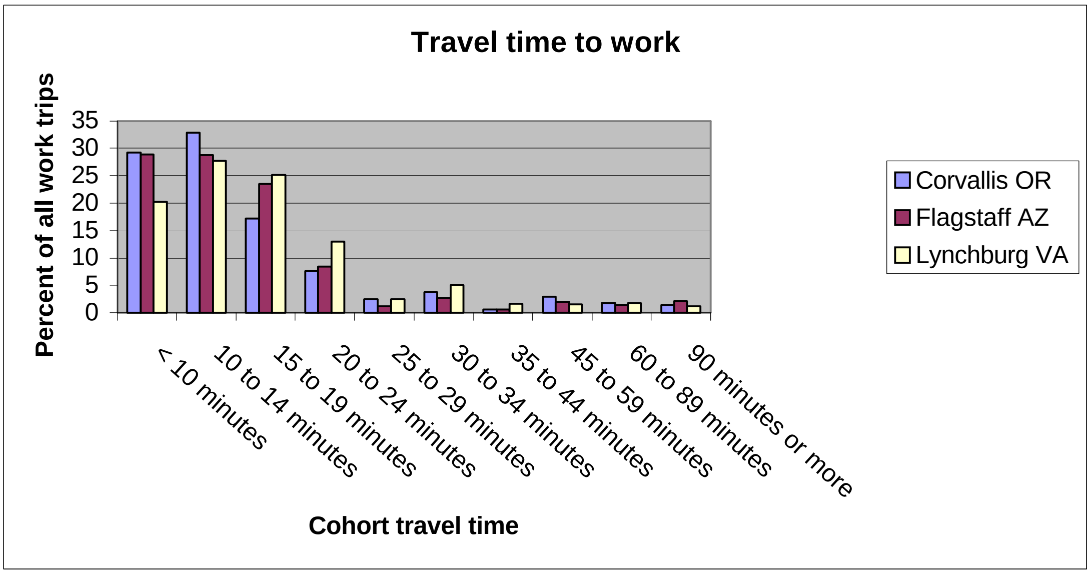

Figure 10: Travel time to work for American selected cities

Source: Census 2000

Fortunately the mean travel time to work for the Dutch cities is available. In this Table 10 you see that this time does not really differ that much between the cities, or between the countries. But at the other hand you have to keep in mind that in the American cities the trips are much more made by faster vehicles like autos. At the other hand this vehicle has to deal with traffic jams, and a bicycle not. In the bike plan of Leiden (1995) for example is written that during rush hours you are faster from A to B by bicycle then by auto in the city.

Table 10: Mean travel time to work in minutes

Mean travel time (in minutes)	
Leiden	15.8
Haarlem	13.9
Rotterdam	15.1
Corvallis OR	15.3
Flagstaff AZ	15.8
Lynchburg VA	16.8

Source: CBS (2000) and Census 2000

Another spatial related factor is the fact how hilly a city is. The theory is that as soon as the surface becomes hillier, people want to use their bicycle less. Therefore, for this study a few maps are created about the percent of slope for a city. For the Netherlands only a map for the whole country is created. This is fair because, especially this part of the Netherlands is very flat. The created maps are available in Appendix D until 0. Here you see that Corvallis is less hilly then Flagstaff and Lynchburg. The highest percent of slope for the city of Corvallis is for example 14.4% compared to 37.9% and 31.5% for Flagstaff and Lynchburg. So as soon as you look at the fact how hilly a city is, this theory is workable for the selected American cities. In case of the Netherlands there nearly is a difference in percent of slope between the selected cities. That’s why in this study mainly the American cities are compared for this factor.

6.4. Weather

Another factor, which influences the bicycle use in a city, are the weather conditions in a city. More or less this is also related to the above spatial characteristics.

For the three Dutch cities the months February, April and May have the less precipitation, but overall the amount of precipitation is more or less similar for all months (see 0). When you compare this to the American cities, the difference between the cities is much bigger. This is nothing to be surprised of, because the selected American cities aren’t as close together as the Dutch cities. For Corvallis for example are the months May, June, July and August very dry, but the rest of the months there is much more precipitation than in the Dutch cities.

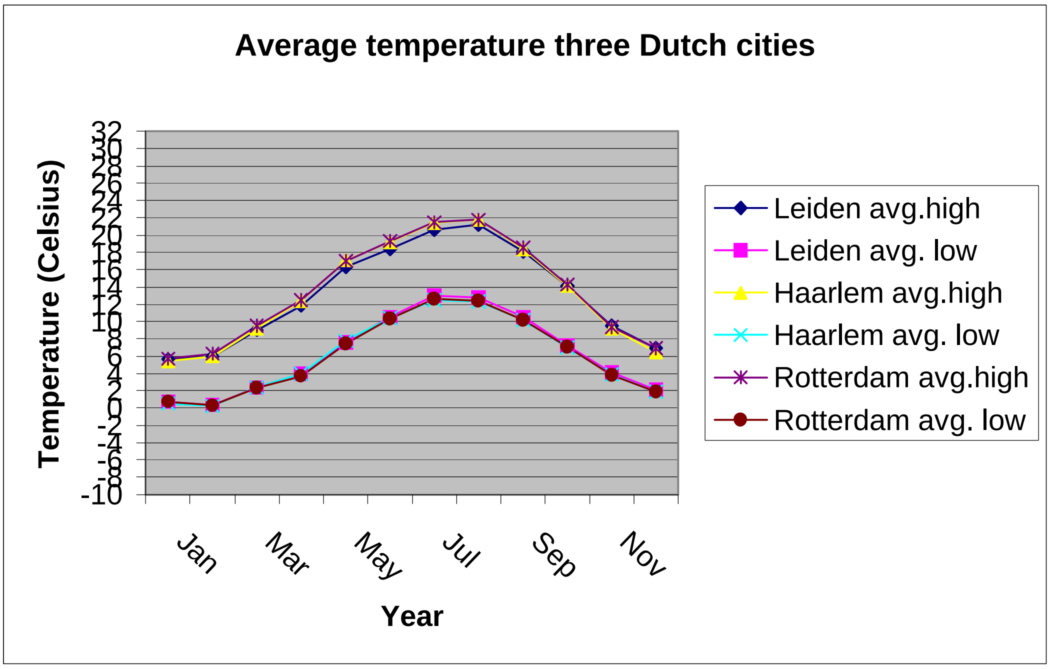

Figure 11: Average temperature selected Dutch cities

Source: Royal Netherlands Meteorological Institute

Another weather characteristic you can look at is the average temperature in a city (Figure 11 and Figure 12). This study makes a difference in the average high and low temperature. The reason behind this is when the difference between the high and low average temperatures is big; the temperature forecast is more unpredictable.

For the Dutch cities the difference isn't that big. Besides that the average low temperature doesn't come below the freezing point. This again is a very positive factor for the bicycle use. When you compare this with the temperature characteristics of the American cities you see that first of all the difference between the high and low temperature is bigger. Second of all you see that for Flagstaff and Lynchburg the average low temperature is below freezing point. Besides this, when you compare the temperature curves you see that the American curves are steeper. This implies that the difference between the months in the American cities is bigger and that there are certain months when it's very hard to drive your bicycle because of this. The average high temperatures for the American cities reach for example thirty degrees Celsius, which is very hot. When you want to ride your bicycle in these temperatures together with the high humidity level, it's more difficult.

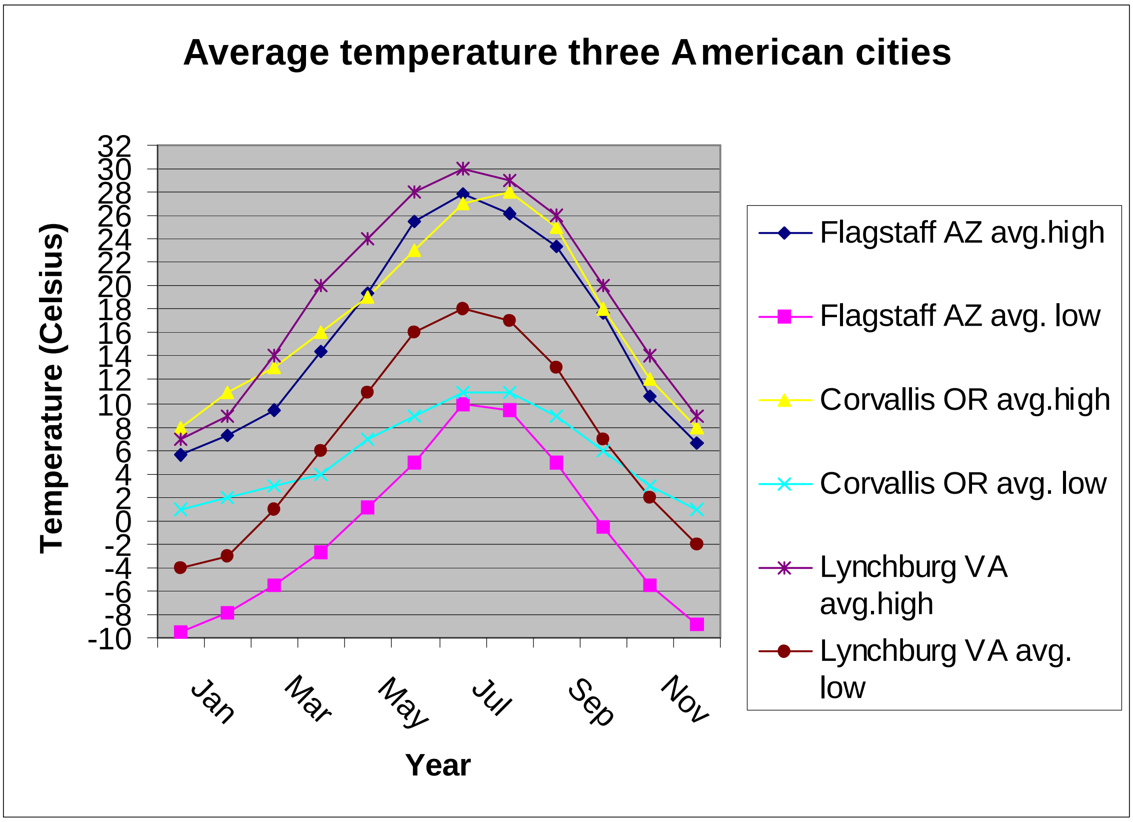

Figure 12: Average temperature selected American cities

Source: The Weather Channel (minimum period of record: 30 years) and USA today

6.5. Competition

The last factor this study focus on is the competition of other transportation modes for the bicycle. Still the auto is a transportation mode which influences the bicycle use in a city.

For example in 1995 (NPTS) 65,2% of all the trips in the United States for a short distance less than 0.5 miles, was made by a ‘privately owned vehicle’ (POV). As soon as you look at longer distances, the percent of trips made by a POV increases. It goes from 87.1% for 0.5 to 1 mile, to 92.2% for the category 1 till 2 miles, to 94.3% for trips between 2 and 3 miles (NPTS, 1995).

Therefore this study looks at the auto availability for the diverse cities (see Figure 13 and Figure 14). Unfortunately this information is not available for the Dutch cities. That’s why only information about the auto availability for the category ‘very urban’ for this country is visualized in Figure 13.

When you compare this category with the American cities it's obvious that the amount of families who have access to more than one auto is much higher in America compared to the Netherlands. This is a result of the low auto price availability and low gas prices in the States compared to the Netherlands (McClintock, 1992). Census 2000 even makes a distinction between auto availability of families in owner-occupied and renter-occupied houses. When you look at these two categories you clearly see that most families in owner-occupied houses have at least two automobiles. This is different from the families in renter-occupied houses where most of them have one or no auto. Even though, when you compare this auto availability with the Dutch one, the families in renter-occupied houses have more autos available. This is not very surprising, because most grocery stores for example in the United States are primarily reachable with an auto. A lot of these stores are situated near a busy highway compared to places which are easily reachable with bikes in the Netherlands. Besides for grocery stores, this is also the case for other stores.

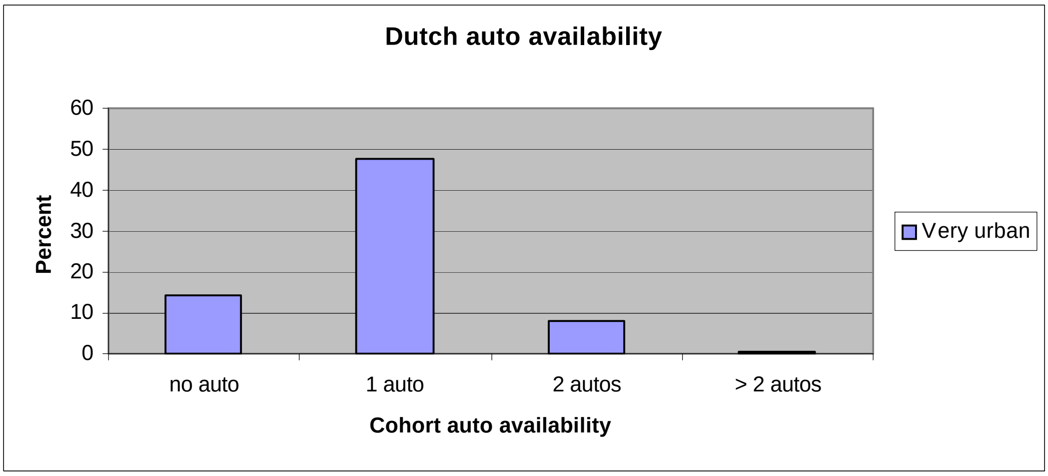

Figure 13: Dutch auto availability

Source: CBS (2000)

When you focus on the difference in the auto availability of the three American cities you only see a difference for the renter-occupied families for the city of Lynchburg (see Figure 14). Unfortunately this study can't explain this difference between the cities. Besides this, the cities are more or less similar for the auto availability.

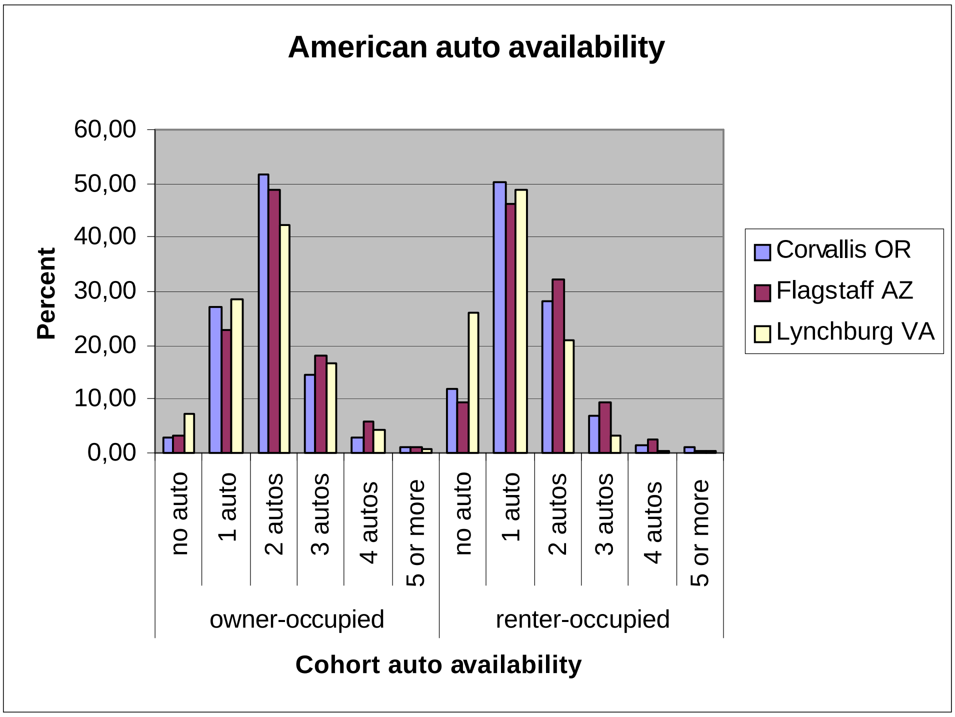

Figure 14: Auto availability in selected American cities

Source: Census 2000

7. Conclusions and recommendations

The last chapter of this paper is about the conclusions and recommendations of this study. The conclusions are primarily based on the results from chapter 5 and 6. Besides this, this last chapter also provides recommendations for the cities to improve their bicycle use.

7.1. Conclusions

The hypothesis of this study is that the most important factor, which affects the bicycle use in a city, is the bike policy. This hypothesis is tested in chapter 5. There we checked the bike plans for the four major requirements diagnostic, strategies, objectives, and public support. Overall you see that the cities with the highest bicycle use in a country score better compared to the other two cities per country. According to this, the hypothesis is proved.

7.1.1. Bicycle plans

When you look for example to the first requirement diagnostic, you see that the city with a high bicycle use has a lot of data related to this transportation mode. These cities have a clear view about the cyclists in the city. This is the opposite for the cities with a lower bicycle use where there is no or very few information about the modal choice and the trip purpose of the cyclists in the city available. Herewith, these cities have no idea about the black spots in the bike network.

For the strategy requirement you can say that bike plans of the cities Leiden and Corvallis are also the best compared to the others. These cities do have the clearest strategies and the bike plan of Leiden is even based on a traffic model, which helps to be more objective.

As far as it is the objectives concerned, you see that there is a clear difference between the Dutch and American cities. The Dutch plans have a shorter planning horizon then the American bike plans. This implies that the American cities have the idea that the bike use will remain the same over time, which doesn’t have to be the case. As soon as you have a shorter planning horizon, the city has to check earlier if the bike policy is still up-to-date enough. In this way the city is forced to think about the bike policy regularly.

7.1.2. Other causal factors

As far as it is the other causal factors concerned, you see that there are a few slight differences between the countries and the cities.

The biggest difference socially is for example the way people look at cyclists in general. A lot of Americans still don’t see the bike as a serious transportation mode for commute trips, but more as a way to get your exercise. This is completely different for the Netherlands.

Economically you don’t really see big differences. Both the countries are relatively rich countries. Besides this there is not really a big difference in income. The three cities per country are comparable for the income characteristics.

For the spatial factors you have a different picture. You definitely see that Corvallis is a city that isn’t very hilly. Especially when you compare Corvallis with the two other selected American cities. Also when you look at the weather characteristics you see that Corvallis is favorable compared to Flagstaff and Lynchburg for bicycle use. Corvallis has a moderate climate in contrast with Flagstaff and Lynchburg.

The last factor is the competition factor. The families in the selected American cities definitely have more autos available than the Dutch families. This is a result of a lot of factors where the city council itself doesn’t have that much influence on.

7.2. Recommendations

As a result of these conclusions this paragraph contains some recommendations for the city governments.

As is proved, the bike policy of a city is a very important factor for the bicycle use in a city. This assumes that’s very important to have a good, reliable, and up-to-date bike policy plan. This means that it is recommended having a clear view about the diagnostic elements that are important for the bicycle use in a city. Only in this way, it’s possible to make balanced decisions. For some cities this means that it’s a very time consuming task, but it definitely is worth it. As soon as a city has a clear view about the black spots in a network, the adaptations will be more effective and efficient. Besides this, as soon as the adaptations are based on more objectives grounds, it’s less severe when an official is replaced. Related to this objectivity is the use of a traffic model. As soon as a bike plan is based on a traffic model as well, it’s good for the objectivity of the plan. The city of Flagstaff for example does use a traffic model for the auto use, but not for the bike use. Maybe it’s not possible at the moment because of the lack of diagnostic data but, when these data are available, it’s definitely recommended.

Another recommendation is related to the planning horizon of a plan. It’s important when this period is not too long. Because when it’s too long, officials forget to think about the bike policy, which results in an out-of-date bike policy. Nobody actually knows what the content of the policy plan is. This definitely is a problem for the cities in the United States with a low bicycle use. A lot of cities had to say that they don’t have an up-to-date enough bike plan. This is a severe situation.

Even though it's difficult to have a clear view about the public support of city plans, it's an important aspect of a bike plan. The residents have to know what's going on in their city and the majority has to support it.

Unfortunately a city government can do less about the other causal factors that affects the bike use. An overall recommendation is that officials take bike use serious. It definitely is possible to use your bicycle for commute trips.

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Appendix A Dutch cities ranked to bicycle use

Source: CBS (2000)

Table 11: Dutch ‘very urban’ cities ranked to bicycle use

Very urban	Bicycle (%)	Walking (%)
Leiden	37.9	19.0
Groningen	37.1	22.1
Utrecht	30.7	22.9
Delft	28.9	23.7
Haarlem	25.8	21.9
Amsterdam	25.7	26.4
Voorburg	21.8	20.3
Vlaardingen	21.8	23.1
Schiedam	21.8	25.3
Rijswijk	21.4	21.4
's-Gravenhage	20.3	26.2
Rotterdam	16.4	26.9

Table 12: Dutch 'strong urban' cities ranked to bicycle use

Strong urban	Bicycle (%)	Walking (%)
Zwolle	38.4	17.0
Vlissingen	38.2	19.6
Middelburg	35.6	17.5
Leeuwarden	35.3	20.6
Katwijk	34.9	18.7
Alkmaar	33.4	21.1
Voorschoten	33.1	15.0
Apeldoorn	33.0	15.9
Enschede	32.5	17.2
Veenendaal	32.3	15.8
Hengelo (O.)	32.2	15.5

Strong urban	Bicycle (%)	Walking (%)
Gouda	31.8	21.7
Deventer	31.3	18.4
Den Helder	31.0	20.1
Nijmegen	30.3	20.4
Rijnsburg	30.0	17.9
Amersfoort	29.5	20.2
Heemskerk	28.2	17.0
Oegstgeest	27.0	16.9
Zaanstad	26.8	19.5
Huizen	26.5	15.5
Tilburg	26.4	17.8
Eindhoven	26.2	20.1
Dordrecht	26.2	21.7
Leiderdorp	26.1	17.6
Gorinchem	25.9	19.9
Hilversum	25.1	20.5
Nieuwegein	25.0	15.9
Velsen	24.8	20.5
Breda	24.8	19.0
Bussum	24.8	21.2
Beverwijk	24.7	23.0
Zwijndrecht	24.6	18.1
Helmond	24.4	20.3
Maassluis	24.4	24.7
Alphen aan den Rijn	24.3	17.5
Zoetermeer	23.9	19.1
's-Hertogenbosch	23.9	20.8
Arnhem	23.8	21.8
Krimpen aan den IJssel	23.2	21.5

Strong urban	Bicycle (%)	Walking (%)
Weesp	23.1	17.8
Spijkenisse	23.0	18.9
Maastricht	22.7	22.7
Bergen op Zoom	22.5	22.5
Ridderkerk	22.0	18.4
Leidschendam	22.0	20.1
Hellevoetsluis	21.6	20.4
IJsselstein	21.4	14.3
Purmerend	21.4	19.7
Papendrecht	20.5	18.7
Diemen	19.6	20.8
Amstelveen	19.4	18.2
Capelle aan den IJssel	14.9	18.0
Heerlen	12.5	24.9
Brunssum	12.1	27.8

Table 13: Dutch 'moderate urban' cities ranked to bicycle use

Moderate urban	Bicycle (%)	Walking (%)
Wageningen	40.5	18.2
Kampen	36.6	18.8
Baarn	36.5	12.3
Meppel	36.4	14.4
Houten	36.1	16.9
Hoorn	35.7	16.9
Harderwijk	35.6	14.9
Winterswijk	35.0	12.4
Oud-Beijerland	34.2	11.3
Sneek	33.8	23.2
Heerenveen	33.4	17.7

Moderate urban	Bicycle (%)	Walking (%)
Goes	33.4	14.0
Doetinchem	32.9	14.0
Wormerland	32.5	11.6
Warnsveld	31.7	13.8
Castricum	31.7	20.1
Hoogeveen	31.6	14.3
Schipluiden	31.3	17.6
's-Gravenzande	31.3	17.6
Wateringen	31.3	17.6
Smallingerland	31.0	16.5
Leerdam	30.7	18.8
Zutphen	30.6	19.9
Heerhugowaard	30.3	16.5
Sassenheim	30.0	17.9
Voorhout	30.0	17.9
Enkhuizen	29.5	16.6
Tiel	29.5	15.1
Venlo	29.3	20.4
Almelo	29.2	17.0
Ede	29.2	17.0
Oldenzaal	29.0	20.5
Assen	29.0	14.0
Zeist	28.9	17.6
Edam-Volendam	28.9	22.7
Culemborg	28.8	16.0
Woerden	28.8	16.1
Goirle	28.6	18.6
Heiloo	28.5	17.8
Borne	28.4	18.1

Moderate urban	Bicycle (%)	Walking (%)
Veldhoven	28.4	18.4
Roermond	28.2	20.8
Bodegraven	28.2	17.4
Schoonhoven	28.2	17.4
Geldrop	28.2	21.4
De Bilt	28.1	17.1
Vught	27.7	12.5
Best	27.6	16.2
Oss	27.2	16.7
Winschoten	27.0	14.4
Leusden	27.0	16.8
Naaldwijk	26.4	15.8
Weert	26.4	21.6
Rheden	26.2	15.3
Dongen	26.1	16.9
Heemstede	26.0	20.8
Uithoorn	26.0	19.9
Alblasserdam	25.8	18.1
Ouder-Amstel	25.8	15.4
Zevenaar	25.7	15.5
Barendrecht	25.7	19.9
Roosendaal	25.6	21.2
Waalwijk	25.5	15.7
Lisse	25.5	17.6
Valkenswaard	25.5	19.9
Wijk bij Duurstede	25.3	18.1
Hendrik-Ido-Ambacht	25.2	15.9
Uden	24.9	17.5
Bergschenhoek	24.8	16.9

Moderate urban	Bicycle (%)	Walking (%)
Rozenburg	24.8	16.9
Hoogezand-Sappemeer	24.4	19.9
Etten-Leur	24.4	16.5
Noordwijk	24.4	22.3
Hillegom	24.3	17.4
Westervoort	24.1	18.3
Wijchen	24.1	15.9
Maarssen	23.6	18.4
Duiven	23.5	18.9
Naarden	23.1	17.8
Soest	23.0	15.1
Oosterhout	22.4	19.7
Wassenaar	22.2	13.2
Nieuwerkerk aan den IJssel	22.1	13.6
Sliedrecht	21.0	19.3
Waddinxveen	20.8	20.0
Haarlemmermeer	20.8	13.3
Monster	20.5	18.5
Bloemendaal	20.4	21.0
Zandvoort	20.4	21.0
Lelystad	20.3	15.5
Sittard-Geleen	19.9	22.0
Almere	19.9	20.2
Landgraaf	12.9	20.5
Kerkrade	7.9	26.0

Appendix B American cities ranked to bicycle use

Source: Census 2000

Table 14: American MSA's and CMSA's ranked to bicycle use

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Corvallis	Oregon	MSA	4.83	7.71	1.59	81.18	0.32
Missoula	Montana	MSA	3.59	5.49	1.33	84.40	0.66
Eugene and Springfield	Oregon	MSA	3.04	4.17	3.28	83.97	0.45
Gainesville	Florida	MSA	2.78	3.24	2.44	87.80	0.53
Santa Barbara, Santa Maria and Lompoc	California	MSA	2.69	3.98	2.44	85.44	0.81
Chico and Paradise	California	MSA	2.55	3.41	1.11	87.76	0.85
Fort Collins and Loveland	Colorado	MSA	2.39	2.74	0.85	88.52	0.41
Bryan and College Station	Texas	MSA	2.33	3.30	0.97	90.07	0.79
Flagstaff	Arizona and Utah	MSA	2.23	7.46	0.69	84.65	0.84
Champaign and Urbana	Illinois	MSA	1.80	8.50	4.91	80.66	0.47
Madison	Wisconsin	MSA	1.74	6.15	4.15	83.84	0.29
Bloomington	Indiana	MSA	1.58	8.56	1.84	84.07	0.45
Iowa City	Iowa	MSA	1.50	10.00	5.32	79.55	0.59
Tucson	Arizona	MSA	1.43	2.59	2.53	88.96	0.85
Sacramento and Yolo	California	CMSA	1.36	2.17	2.72	89.07	0.65
Bellingham	Washington	MSA	1.35	4.15	2.01	86.62	0.84
San Luis Obispo, Atascadero and Paso Robles	California	MSA	1.28	3.70	0.99	87.73	0.72
San Francisco, Oakland and	California	CMSA	1.12	3.25	9.48	81.36	0.72

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
San Jose							
Lawrence	Kansas	MSA	1.05	6.71	0.98	87.22	0.36
Boise City	Idaho	MSA	0.99	2.19	0.68	91.36	0.64
Grand Junction	Colorado	MSA	0.97	2.79	0.50	89.46	1.00
Columbia	Missouri	MSA	0.95	4.70	0.72	90.02	0.42
Phoenix and Mesa	Arizona	MSA	0.94	2.09	2.02	90.38	0.91
Honolulu	Hawaii	MSA	0.93	5.58	8.31	81.45	0.84
Yuma	Arizona	MSA	0.89	4.32	1.13	90.47	1.31
Lincoln	Nebraska	MSA	0.89	3.23	1.16	90.94	0.60
Medford and Ashland	Oregon	MSA	0.84	3.56	0.67	88.47	0.84
Merced	California	MSA	0.82	2.96	0.71	91.45	0.83
Salinas	California	MSA	0.82	3.83	2.18	88.42	1.15
Lafayette	Indiana	MSA	0.81	5.91	1.35	88.49	0.67
State College	Pennsylvania	MSA	0.80	12.43	3.91	78.41	0.45
Sarasota and Bradenton	Florida	MSA	0.80	1.55	0.66	92.08	0.83
Albuquerque	New Mexico	MSA	0.78	2.32	1.25	91.16	0.60
Elkhart and Goshen	Indiana	MSA	0.76	1.95	0.48	92.88	0.59
Provo and Orem	Utah	MSA	0.76	4.92	1.39	87.48	0.40
Fort Myers and Cape Coral	Florida	MSA	0.76	1.48	0.77	92.63	0.90
Portland and Salem	Oregon and Washington	CMSA	0.76	2.98	5.71	85.31	0.64
Stockton and Lodi	California	MSA	0.70	2.32	1.43	91.75	0.93
Ponce	Puerto Rico	MSA	0.70	4.27	4.62	87.16	1.47
Denver, Boulder and Greeley	Colorado	CMSA	0.69	2.38	4.34	87.26	0.61
Naples	Florida	MSA	0.69	1.80	1.91	89.48	1.39

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Modesto	California	MSA	0.69	2.39	0.97	92.06	0.66
Sheboygan	Wisconsin	MSA	0.68	3.76	0.81	91.24	0.51
Fresno	California	MSA	0.68	2.39	1.61	91.12	1.00
Reno	Nevada	MSA	0.67	3.17	3.19	89.30	0.74
Santa Fe	New Mexico	MSA	0.66	3.04	0.80	87.85	0.73
Visalia, Tulare and Porterville	California	MSA	0.65	2.45	0.92	91.12	1.33
Athens	Georgia	MSA	0.64	3.23	1.64	91.35	0.59
Los Angeles, Riverside and Orange County	California	CMSA	0.63	2.56	4.66	87.81	0.76
Melbourne, Titusville and Palm Bay	Florida	MSA	0.62	1.29	0.29	94.43	0.68
Tampa, St. Petersburg and Clearwater	Florida	MSA	0.62	1.71	1.40	92.31	0.82
Charlottesville	Virginia	MSA	0.62	5.39	2.38	86.23	0.49
Seattle, Tacoma and Bremerton	Washington	CMSA	0.60	3.17	6.75	84.61	0.66
Pocatello	Idaho	MSA	0.60	2.89	1.65	91.60	0.37
New Orleans	Louisiana	MSA	0.59	2.72	5.60	87.78	0.90
La Crosse	Wisconsin and Minnesota	MSA	0.59	4.90	1.11	89.30	0.33
Austin and San Marcos	Texas	MSA	0.58	2.08	2.57	90.42	0.76
Spokane	Washington	MSA	0.57	2.83	2.79	89.17	0.54
San Diego	California	MSA	0.57	3.39	3.37	87.25	1.02
Fort Pierce and Port St. Lucie	Florida	MSA	0.57	1.15	0.77	93.23	0.79
Rochester	Minnesota	MSA	0.55	3.76	3.12	88.55	0.31
Savannah	Georgia	MSA	0.55	2.35	2.54	91.40	0.79

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Daytona Beach	Florida	MSA	0.54	1.84	1.00	92.81	0.85
Mayagnez	Puerto Rico	MSA	0.54	4.54	3.18	88.51	1.62
Bakersfield	California	MSA	0.54	1.91	1.37	92.47	1.02
Lansing and East Lansing	Michigan	MSA	0.53	3.96	1.58	90.41	0.29
Panama City	Florida	MSA	0.53	1.64	0.31	94.26	0.95
Enid	Oklahoma	MSA	0.52	1.92	0.30	93.88	0.38
West PalmBeach and Boca Raton	Florida	MSA	0.51	1.36	1.40	91.72	0.91
Anchorage	Alaska	MSA	0.51	2.66	2.02	89.05	2.05
Billings	Montana	MSA	0.50	2.54	1.09	91.22	0.57
Fort Walton Beach	Florida	MSA	0.50	1.49	0.31	94.85	0.79
Las Cruces	New Mexico	MSA	0.50	2.51	0.45	92.03	0.98
Burlington	Vermont	MSA	0.48	6.15	1.33	87.53	0.41
Myrtle Beach	South Carolina	MSA	0.48	1.73	0.54	93.54	1.05
Jacksonville	Florida	MSA	0.47	1.67	1.52	93.06	0.98
Fargo and Moorhead	North Dakota and Minnesota	MSA	0.47	4.73	0.47	90.45	0.39
Las Vegas	Nevada and Arizona	MSA	0.47	2.38	4.06	89.88	0.86
Charleston and North Charleston	South Carolina	MSA	0.46	3.46	1.61	91.24	1.01
Punta Gorda	Florida	MSA	0.46	0.75	0.24	94.35	0.96
Miami and Fort Lauderdale	Florida	CMSA	0.46	1.77	3.90	90.20	0.89
Lancaster	Pennsylvania	MSA	0.45	4.35	1.19	88.47	0.70
Minneapolis and St. Paul	Minnesota and Wisconsin	MSA	0.44	2.44	4.46	88.43	0.44
Waterloo and Cedar Falls	Iowa	MSA	0.43	4.17	0.81	91.30	0.38

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Appleton, Oshkosh and Neenah	Wisconsin	MSA	0.43	3.29	0.73	92.14	0.37
Portland	Maine	MSA	0.43	3.88	1.70	89.28	0.44
Salt Lake City and Ogden	Utah	MSA	0.43	1.84	2.98	90.42	0.57
Orlando	Florida	MSA	0.42	1.29	1.69	92.91	0.82
Colorado Springs	Colorado	MSA	0.42	3.71	0.95	90.19	0.68
St. Cloud	Minnesota	MSA	0.42	4.84	1.24	87.62	0.36
Eau Claire	Wisconsin	MSA	0.42	4.65	1.01	89.14	0.48
Greenville	North Carolina	MSA	0.41	2.39	0.81	93.43	0.81
Wilmington	North Carolina	MSA	0.41	1.69	0.85	93.00	1.02
Kokomo	Indiana	MSA	0.40	1.45	0.35	95.02	0.49
Pueblo	Colorado	MSA	0.40	1.90	0.74	93.20	0.48
Great Falls	Montana	MSA	0.39	3.33	0.80	91.29	0.35
Tallahassee	Florida	MSA	0.39	1.86	1.48	93.35	0.50
Boston, Worcester and Lawrence	Massachusetts, New Hampshire, Maine and Connecticut	CMSA	0.38	4.12	9.03	82.76	0.54
Muncie	Indiana	MSA	0.38	4.76	1.10	90.74	0.35
Yuba City	California	MSA	0.38	2.10	0.65	92.30	1.13
Lexington	Kentucky	MSA	0.38	3.86	0.87	91.70	0.47
Bloomington and Normal	Illinois	MSA	0.37	5.25	1.10	89.69	0.39
Elmira	New York	MSA	0.37	4.06	1.12	91.73	0.41
Erie	Pennsylvania	MSA	0.37	4.27	1.40	91.18	0.51
Florence	South Carolina	MSA	0.37	1.44	1.02	94.63	0.97
Raleigh, Durham	North	MSA	0.36	2.29	1.69	91.54	0.65

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
and Chapel Hill	Carolina						
Redding	California	MSA	0.36	2.24	0.88	91.86	0.58
Lakeland and Winter Haven	Florida	MSA	0.36	1.41	0.74	94.42	0.99
Lake Charles	Louisiana	MSA	0.36	1.56	0.44	95.07	0.86
Aguadilla	Puerto Rico	MSA	0.35	4.59	2.24	89.24	1.59
Springfield	Massachusetts	MSA	0.35	5.13	2.62	88.83	0.48
Lafayette	Louisiana	MSA	0.35	1.75	0.89	93.49	1.22
Goldsboro	North Carolina	MSA	0.35	1.99	0.45	94.70	0.65
Grand Forks	North Dakota and Minnesota	MSA	0.35	4.75	0.77	89.70	0.57
Pensacola	Florida	MSA	0.34	4.54	1.05	90.38	1.09
Lewiston and Auburn	Maine	MSA	0.34	4.45	1.00	91.18	0.65
Williamsport	Pennsylvania	MSA	0.34	3.96	1.08	91.66	0.61
Cheyenne	Wyoming	MSA	0.33	2.20	0.38	92.84	0.61
Philadelphia, Wilmington and Atlantic City	Pennsylvania, New York and Delaware	CMSA	0.33	3.88	8.73	83.64	0.57
Baton Rouge	Louisiana	MSA	0.33	1.98	1.05	93.77	0.72
Ocala	Florida	MSA	0.33	1.42	0.23	94.04	0.85
Norfolk, Virginia Beach and Newport News	Virginia and North Carolina	MSA	0.31	2.67	1.87	91.08	1.38
Chicago, Gary and Kenosha	Illinois and Indiana and Wisconsin	CMSA	0.31	3.13	11.49	81.49	0.70
Houston, Galveston and Brazoria	Texas	CMSA	0.30	1.62	3.28	91.40	0.92

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Lima	Ohio	MSA	0.30	2.48	0.66	93.44	0.56
New York, Northern New Jersey and Long Island	New York and New Jersey	CMSA	0.30	5.55	24.90	65.72	0.56
Waco,	Texas	MSA	0.30	2.26	0.76	93.51	0.65
Hattiesburg	Mississippi	MSA	0.29	2.69	0.38	93.71	0.67
Joplin	Missouri	MSA	0.29	2.02	0.21	93.79	0.69
Auburn and Opelika,	Alabama	MSA	0.29	1.88	0.54	95.00	0.51
Cedar Rapids	Iowa	MSA	0.29	2.65	1.13	92.62	0.38
Springfield	Missouri	MSA	0.29	2.13	0.67	92.74	0.63
South Bend	Indiana	MSA	0.28	3.91	1.24	91.57	0.40
Springfield	Illinois	MSA	0.28	2.08	1.60	92.94	0.36
Richland, Kennewick and Pasco	Washington	MSA	0.28	1.71	1.02	92.48	0.73
Corpus Christi	Texas	MSA	0.28	2.10	1.65	92.49	1.11
York	Pennsylvania	MSA	0.27	2.16	0.62	93.90	0.37
Abilene	Texas	MSA	0.27	2.45	0.52	93.96	0.82
Houma	Louisiana	MSA	0.27	1.90	0.78	92.63	2.37
Brownsville, Harlingen and San Benito	Texas	MSA	0.26	2.34	0.76	92.69	1.42
Wausau	Wisconsin	MSA	0.26	2.64	0.96	90.62	0.44
Richmond and Petersburg	Virginia	MSA	0.26	1.86	2.08	92.49	0.66
Lawton	Oklahoma	MSA	0.26	7.29	0.96	87.40	1.83
Washington and Baltimore	District of Columbia, Maryland, Virginia and	CMSA	0.25	2.98	9.43	83.28	0.57

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
	West Virginia						
Yakima	Washington	MSA	0.25	2.65	0.54	91.98	1.07
Bangor	Maine	MSA	0.25	5.15	1.19	89.21	0.57
Green Bay	Wisconsin	MSA	0.25	2.80	0.87	93.13	0.41
Sherman and Denison	Texas	MSA	0.24	1.84	0.17	94.23	0.66
Mansfield	Ohio	MSA	0.24	1.99	0.56	93.97	0.53
Lubbock	Texas	MSA	0.24	1.81	0.88	93.95	0.68
Providence, Fall River and Warwick	Rhode Island and Massachusetts	MSA	0.24	3.28	2.48	91.32	0.58
Benton Harbor	Michigan	MSA	0.24	2.87	0.62	92.30	0.72
Harrisburg, Lebanon and Carlisle	Pennsylvania	MSA	0.24	3.57	1.27	91.25	0.56
Kalamazoo and Battle Creek	Michigan	MSA	0.23	2.70	1.03	92.67	0.45
Jamestown	New York	MSA	0.23	5.09	1.17	89.61	0.56
Grand Rapids, Muskegon and Holland	Michigan	MSA	0.23	2.06	0.84	93.21	0.56
Beaumont and Port Arthur	Texas	MSA	0.23	1.33	0.63	95.21	0.92
Jacksonville	North Carolina	MSA	0.23	10.35	0.83	84.03	2.11
Dover	Delaware	MSA	0.23	2.28	0.78	92.75	0.86
Killeen and Temple	Texas	MSA	0.23	4.70	0.26	92.17	0.87
Toledo	Ohio	MSA	0.23	2.39	1.42	93.45	0.45
Rockford	Illinois	MSA	0.23	1.63	0.88	93.85	0.57
Fayetteville, Springdale and	Arkansas	MSA	0.23	2.31	0.35	93.05	0.67

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Rogers							
Milwaukee and Racine	Wisconsin	CMSA	0.23	2.76	4.02	90.05	0.39
Columbus	Ohio	MSA	0.22	2.38	2.31	91.69	0.43
Binghamton	New York	MSA	0.22	3.86	2.34	90.51	0.42
Clarksville and Hopkinsville	Tennessee and Kentucky	MSA	0.22	3.79	0.82	92.07	1.02
Biloxi, Gulfport and Pascagoula	Mississippi	MSA	0.22	2.92	0.45	93.50	0.88
Reading	Pennsylvania	MSA	0.22	3.63	1.65	91.17	0.45
Asheville	North Carolina	MSA	0.22	2.04	0.77	92.69	0.53
Glens Falls	New York	MSA	0.22	3.46	0.87	91.07	0.56
Owensboro	Kentucky	MSA	0.22	1.51	0.29	95.48	0.54
Oklahoma City	Oklahoma	MSA	0.20	1.68	0.60	93.90	0.77
Syracuse	New York	MSA	0.20	4.09	1.96	90.31	0.47
Buffalo and Niagara Falls	New York	MSA	0.20	2.70	3.51	91.15	0.34
New London and Norwich	Connecticut and Rhode Island	MSA	0.20	3.56	1.64	91.57	0.61
Decatur	Illinois	MSA	0.20	2.09	0.88	93.95	0.40
Davenport, Moline and Rock Island	Iowa and Illinois	MSA	0.20	2.28	0.93	93.05	0.62
Sumter	South Carolina	MSA	0.19	1.17	0.85	95.11	1.05
Fayetteville	North Carolina	MSA	0.19	4.20	0.75	91.64	1.00
Barnstable and Yarmouth	Massachusetts	MSA	0.19	2.28	1.44	90.01	0.99
Alexandria	Louisiana	MSA	0.19	2.20	1.33	92.76	1.12
Rochester	New York	MSA	0.19	3.52	2.00	90.95	0.46

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Louisville	Kentucky and Indiana	MSA	0.19	1.72	2.21	92.96	0.57
Fort Wayne	Indiana	MSA	0.19	1.76	0.63	94.07	0.52
Allentown, Bethlehem and Easton	Pennsylvania	MSA	0.18	3.72	1.31	91.91	0.41
Tuscaloosa	Alabama	MSA	0.18	2.22	0.49	94.63	0.46
Janesville and Beloit	Wisconsin	MSA	0.18	2.69	0.74	93.26	0.40
Utica and Rome	New York	MSA	0.18	4.11	1.42	91.18	0.48
Detroit, Ann Arbor and Flint	Michigan	CMSA	0.18	1.83	1.82	93.46	0.44
Saginaw, Bay City and Midland	Michigan	MSA	0.18	1.54	0.59	94.37	0.45
Terre Haute	Indiana	MSA	0.18	3.31	0.34	93.28	0.60
Des Moines	Iowa	MSA	0.18	2.07	1.59	92.48	0.38
Wichita	Kansas	MSA	0.17	1.57	0.60	94.40	0.52
Fort Smith	Arkansas and Oklahoma	MSA	0.17	1.18	0.53	95.32	0.69
Shreveport and Bossier City	Louisiana	MSA	0.17	1.48	1.73	94.04	0.88
Pittsfield	Massachusetts	MSA	0.17	3.74	1.65	91.36	0.43
Indianapolis	Indiana	MSA	0.17	1.68	1.32	93.31	0.57
Duluth and Superior	Minnesota and Wisconsin	MSA	0.17	4.31	2.08	89.60	0.57
Bismarck	North Dakota	MSA	0.17	2.77	0.44	91.59	0.44
Sioux Falls	South Dakota	MSA	0.17	2.28	0.70	92.99	0.44
Hartford	Connecticut	MSA	0.17	2.53	2.81	91.52	0.45
Augusta and Aiken	Georgia and South Carolina	MSA	0.16	2.66	0.69	94.05	0.73
Dubuque	Iowa	MSA	0.16	4.83	0.58	90.08	0.28

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Cleveland and Akron	Ohio	CMSA	0.16	2.14	3.42	91.10	0.51
Canton and Massillon	Ohio	MSA	0.16	1.95	1.03	94.00	0.46
Albany, Schenectady and Troy	New York	MSA	0.16	3.78	3.24	89.41	0.42
Monroe	Louisiana	MSA	0.16	1.39	1.25	94.63	0.89
Peoria and Pekin	Illinois	MSA	0.16	2.19	1.20	93.37	0.44
San Angelo	Texas	MSA	0.16	4.07	0.40	92.25	0.92
Dayton and Springfield	Ohio	MSA	0.15	2.35	1.81	92.88	0.46
Laredo	Texas	MSA	0.15	2.06	2.54	90.84	1.47
San Juan, Caguas and Arecibo	Puerto Rico	CMSA	0.15	3.53	6.31	86.77	1.50
Sioux City	Iowa and Nebraska	MSA	0.15	2.67	0.90	92.61	0.70
Little Rock and North Little Rock	Arkansas	MSA	0.15	1.29	0.85	94.85	0.60
Wichita Falls	Texas	MSA	0.15	7.02	0.43	89.48	0.85
Columbia	South Carolina	MSA	0.15	3.70	1.32	91.36	1.02
Amarillo	Texas	MSA	0.15	1.31	0.36	95.00	0.69
San Antonio	Texas	MSA	0.14	2.36	2.89	91.07	0.96
Altoona	Pennsylvania	MSA	0.14	3.67	0.45	92.65	0.66
Charleston	West Virginia	MSA	0.14	2.34	1.84	92.65	0.64
Parkersburg and Marietta	West Virginia and Ohio	MSA	0.14	2.58	0.52	93.96	0.55
Dallas and Fort Worth	Texas	CMSA	0.14	1.48	1.81	92.81	0.79
Jackson	Michigan	MSA	0.14	1.88	0.51	94.20	0.48
Macon	Georgia	MSA	0.14	1.32	1.03	95.05	0.68

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Tulsa	Oklahoma	MSA	0.13	1.65	0.68	93.80	0.60
Knoxville	Tennessee	MSA	0.13	1.85	0.52	94.29	0.50
Rapid City	South Dakota	MSA	0.13	2.25	0.55	93.51	0.44
Mobile	Alabama	MSA	0.13	1.25	0.63	94.99	0.69
El Paso	Texas	MSA	0.13	2.18	2.22	92.29	1.02
Casper	Wyoming	MSA	0.13	1.41	0.42	94.14	0.65
Cincinnati and Hamilton	Ohio, Kentucky and Indiana	CMSA	0.12	2.30	2.93	91.44	0.47
Omaha	Nebraska and Iowa	MSA	0.12	1.86	1.14	93.44	0.49
Charlotte, Gastonia and Rock Hill	North Carolina and South Carolina	MSA	0.12	1.21	1.39	93.85	0.65
Sharon	Pennsylvania	MSA	0.12	3.15	0.35	92.47	0.69
Roanoke	Virginia	MSA	0.12	1.62	1.36	94.01	0.57
Pine Bluff	Arkansas	MSA	0.12	1.21	0.46	95.74	0.63
St. Joseph	Missouri	MSA	0.12	1.72	0.66	94.01	0.67
Evansville and Henderson	Indiana and Kentucky	MSA	0.11	2.02	0.82	94.27	0.45
St. Louis	Missouri and Illinois	MSA	0.11	1.62	2.41	92.54	0.47
Greensboro, Winston-Salem and High Point	North Carolina	MSA	0.11	1.55	0.86	94.35	0.71
McAllen, Edinburg and Mission	Texas	MSA	0.11	1.88	0.32	92.87	2.63
Longview and Marshall	Texas	MSA	0.11	1.45	0.19	94.93	0.86
Pittsburgh	Pennsylvania	MSA	0.11	3.58	6.18	87.19	0.51
Greenville,	South	MSA	0.11	1.87	0.43	94.86	0.67

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Spartanburg and Anderson	Carolina						
Albany	Georgia	MSA	0.11	2.02	0.93	94.85	0.61
Huntington and Ashland	West Virginia, Kentucky and Ohio	MSA	0.10	2.73	0.63	93.73	0.65
Hickory, Morganton and Lenoir	North Carolina	MSA	0.10	1.08	0.19	95.96	0.86
Jonesboro	Arkansas	MSA	0.10	1.85	0.12	94.79	0.57
Nashville	Tennessee	MSA	0.10	1.51	0.96	93.55	0.66
Scranton, Wilkes-Barre and Hazleton	Pennsylvania	MSA	0.10	3.71	0.87	92.61	0.54
Dothan	Alabama	MSA	0.10	1.50	0.53	95.30	0.90
Rocky Mount	North Carolina	MSA	0.10	1.19	0.81	95.22	0.77
Atlanta	Georgia	MSA	0.10	1.27	3.65	90.71	0.78
Columbus	Georgia and Alabama	MSA	0.09	5.16	1.18	90.07	1.57
Victoria	Texas	MSA	0.09	1.32	0.13	95.57	0.81
Kansas City	Missouri and Kansas	MSA	0.09	1.36	1.28	93.31	0.55
Huntsville	Alabama	MSA	0.08	1.27	0.35	95.47	0.55
Topeka	Kansas	MSA	0.08	1.23	0.94	94.78	0.41
Chattanooga	Tennessee and Georgia	MSA	0.08	1.48	0.78	94.95	0.56
Memphis	Tennessee, Arkansas and Mississippi	MSA	0.08	1.30	1.72	93.98	0.74
Texarkana and Texarkana	Texas and Arkansas	MSA	0.08	1.43	0.24	95.46	0.80
Anniston	Alabama	MSA	0.08	1.15	0.52	95.87	0.71

Name city	State	MSA or CMSA	Bike	Walk	Public transp	Auto	Other
Cumberland	Maryland and West Virginia	MSA	0.08	3.81	0.48	93.67	0.38
Johnson City, Kingsport and Bristol	Tennessee and Virginia	MSA	0.07	1.33	0.30	95.51	0.53
Steubenville and Weirton	Ohio and West Virginia	MSA	0.07	3.28	0.44	93.83	0.43
Danville	Virginia	MSA	0.07	1.11	0.98	95.13	0.74
Wheeling	West Virginia and Ohio	MSA	0.07	3.57	0.92	92.13	0.64
Montgomery	Alabama	MSA	0.07	1.32	0.56	95.64	0.56
Odessa and Midland	Texas	MSA	0.07	1.19	0.16	95.35	0.85
Jackson	Tennessee	MSA	0.06	1.89	0.70	94.70	0.69
Youngstown and Warren	Ohio	MSA	0.06	1.69	0.58	94.87	0.57
Decatur	Alabama	MSA	0.06	0.96	0.13	96.40	0.52
Birmingham	Alabama	MSA	0.05	1.21	0.81	95.27	0.50
Tyler	Texas	MSA	0.05	1.09	0.32	94.88	1.07
Florence	Alabama	MSA	0.05	1.27	0.16	96.34	0.47
Johnstown	Pennsylvania	MSA	0.03	3.36	0.87	92.14	0.58
Jackson	Mississippi	MSA	0.03	1.43	0.62	95.08	0.69
Gadsden	Alabama	MSA	0.03	0.87	0.11	96.49	0.63
Lynchburg	Virginia	MSA	0.03	2.53	1.15	92.91	0.70

Appendix C Definitions CMSA, MSA, Place, and Urbanized Area

Source: Census 2000

Consolidated and Primary Metropolitan Statistical Area (CMSA and PMSA)

If an area that qualifies as a metropolitan area (MA) has 1 million people or more, two or more primary metropolitan statistical areas (PMSAs) may be defined within it. Each PMSA consists of a large urbanized county or cluster of counties (cities and towns in New England) that demonstrate very strong internal economic and social links, in addition to close ties to other portions of the larger area. When PMSAs are established, the larger MA of which they are component parts is designated a consolidated metropolitan statistical area (CMSA). CMSAs and PMSAs are established only where local governments favor such designations for a large MA.

Metropolitan Statistical Area (MSA)

Metropolitan statistical areas (MSAs) are metropolitan areas (MAs) that are not closely associated with other MAs. These areas typically are surrounded by nonmetropolitan counties (county subdivisions in New England).

Place

Places, for the reporting of decennial census data, include census designated places, consolidated cities, and incorporated places. Each place is assigned a five-digit Federal Information Processing Standards (FIPS) code, based on the alphabetical order of the place name within each state. If place names are duplicated within a state and they represent distinctly different areas, a separate code is assigned to each place name alphabetically by primary county in which each place is located, or if both places are in the same county, alphabetically by their legal description (for example, ‘‘city’’ before ‘‘village’’).

Urbanized Area (UA)

An urbanized area (UA) consists of densely settled territory that contains 50,000 or more people. The U.S. Census Bureau delineates UAs to provide a better separation of urban and rural territory, population, and housing in the vicinity of large places. At least 35,000 people in a UA must live in an area that is not part of a military reservation.

For Census 2000, the UA criteria specify that the delineations be performed using a zero-based approach. Because of the more stringent density requirements and the less restrictive extended place criteria, some territory that was classified as urbanized for the 1990 census has been reclassified as rural. (Area that was part of a 1990 UA has not been automatically grandfathered into the 2000 UA.) In addition, some areas that were identified as UAs for the 1990 census have been reclassified as urban clusters.

Appendix D Elevation the Netherlands

Source: GIS data UNC at Chapel Hill

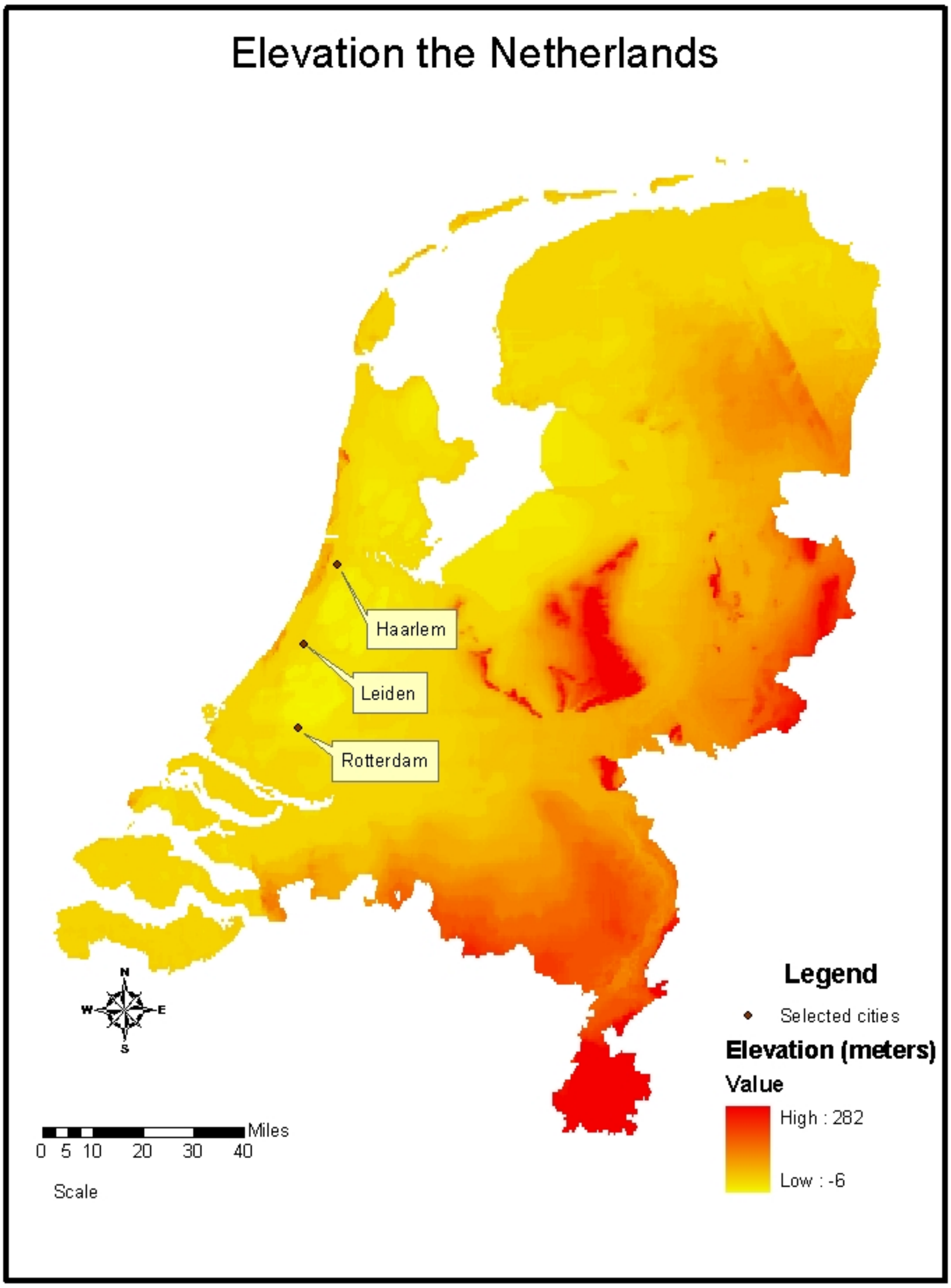

Figure 15: Elevation the Netherlands

Appendix E Percent of Slope Corvallis OR

Source: GIS data UNC at Chapel Hill

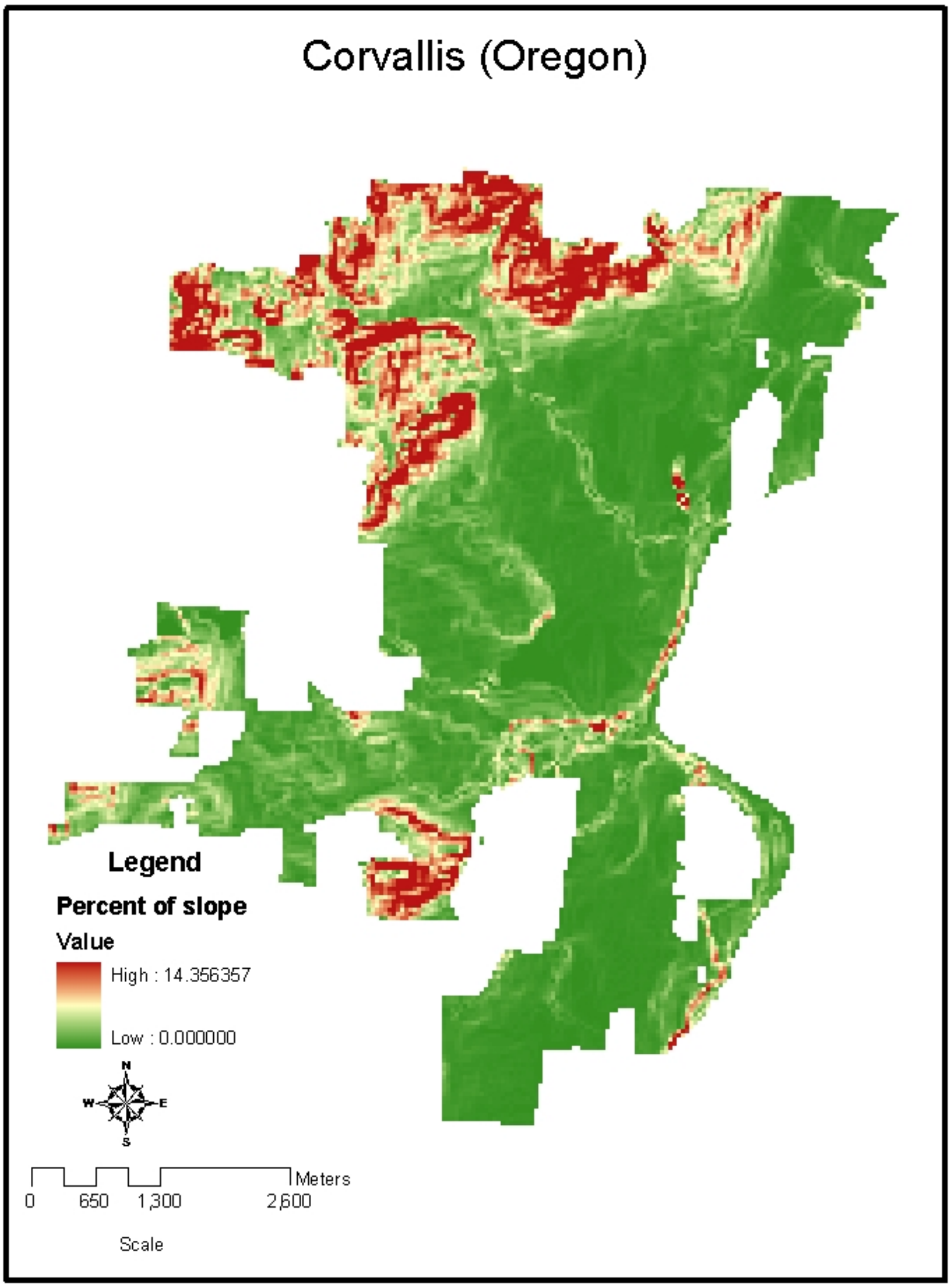

Figure 16: Percent of Slope Corvallis OR

Appendix F Percent of Slope Flagstaff AZ

Source: GIS data UNC at Chapel Hill

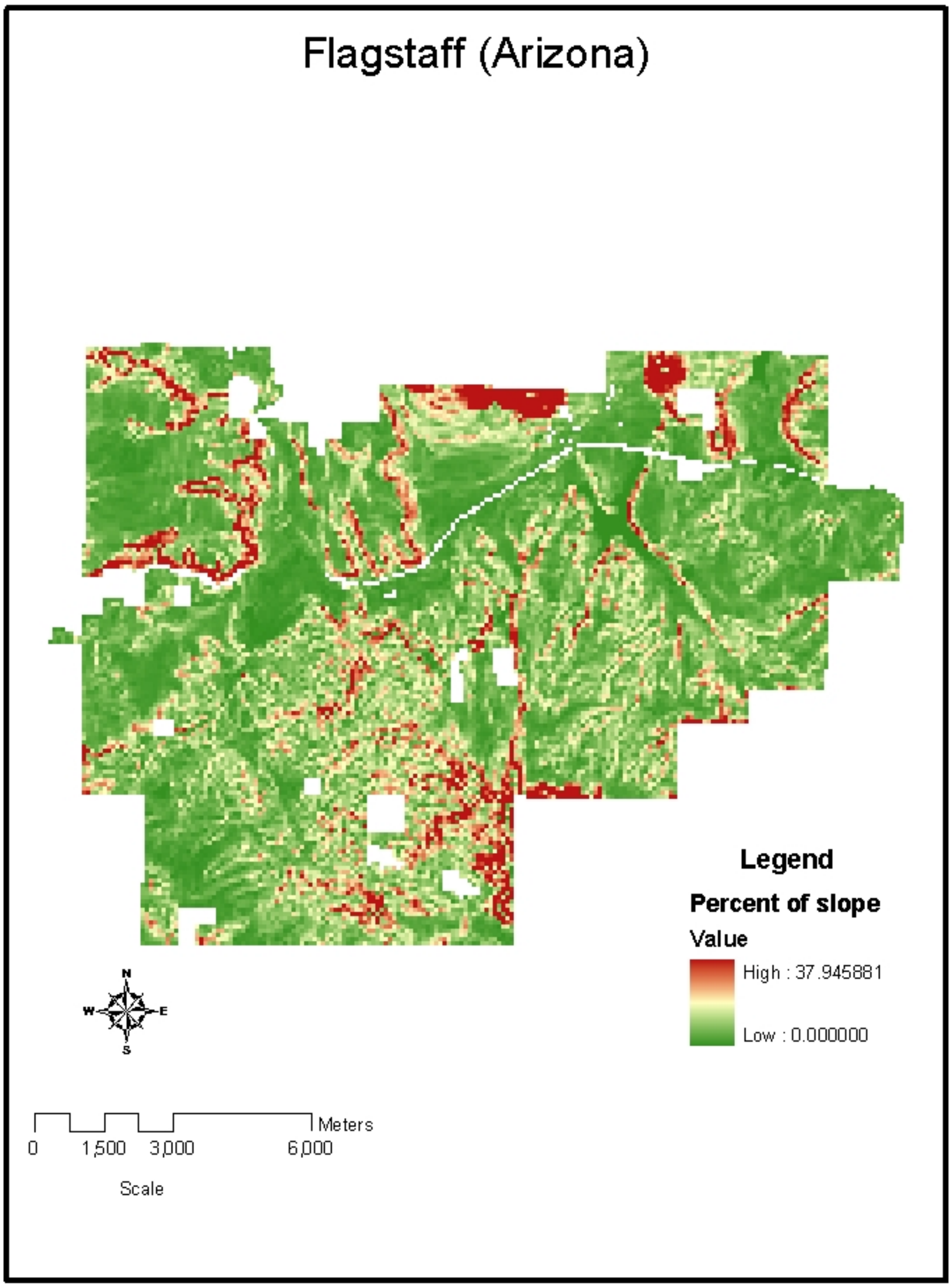

Figure 17: Percent of Slope Flagstaff AZ

Appendix G Percent of Slope Lynchburg VA

Source: GIS data UNC at Chapel Hill

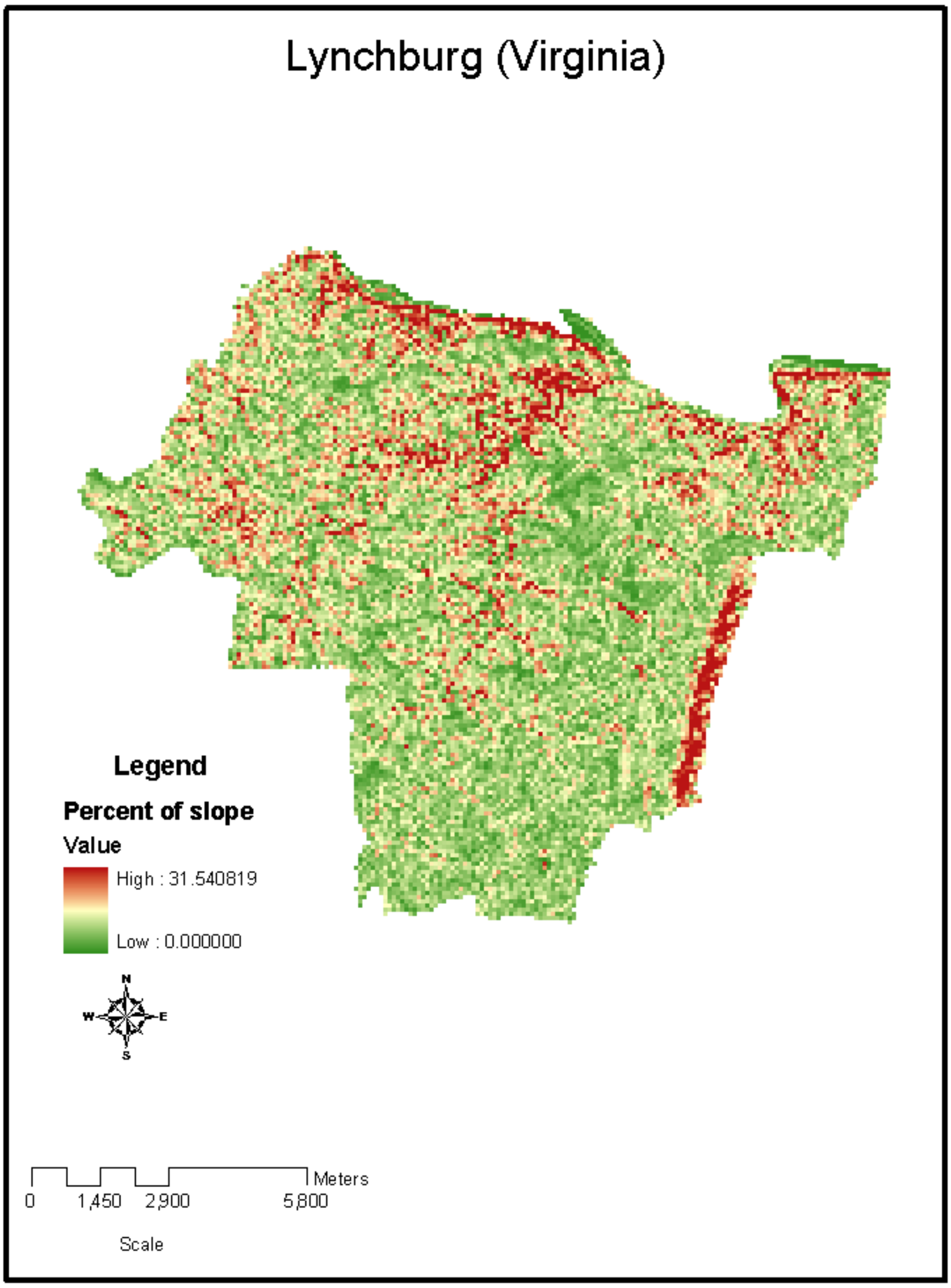

Figure 18: Percent of Slope Lynchburg VA

Appendix H Precipitation characteristics six selected cities

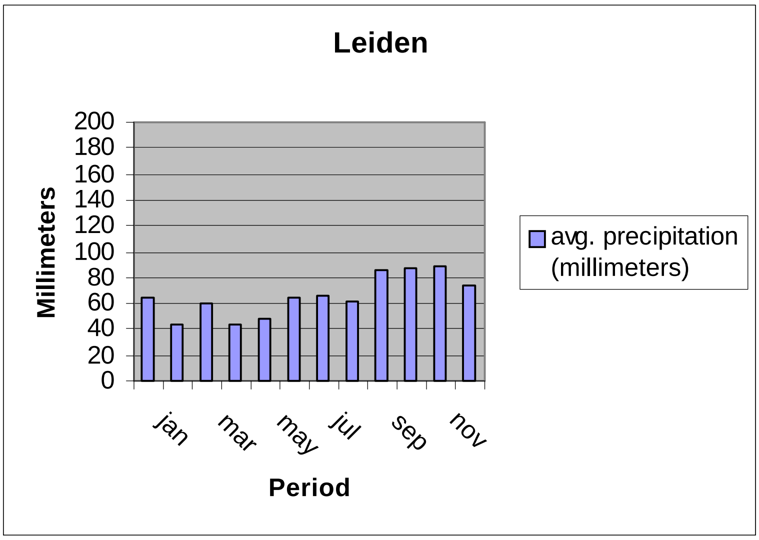

Figure 19: Precipitation characteristics Leiden

Source: Royal Netherlands Meteorological Institute

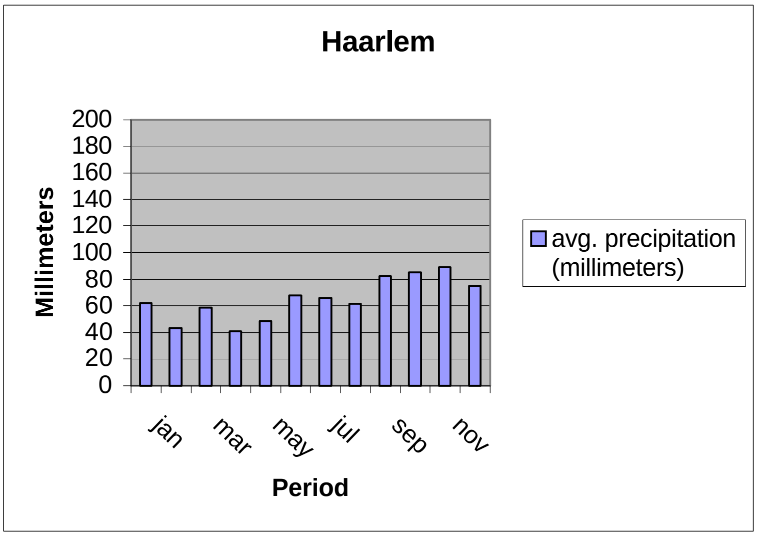

Figure 20: Precipitation characteristics Haarlem

Source: Royal Netherlands Meteorological Institute

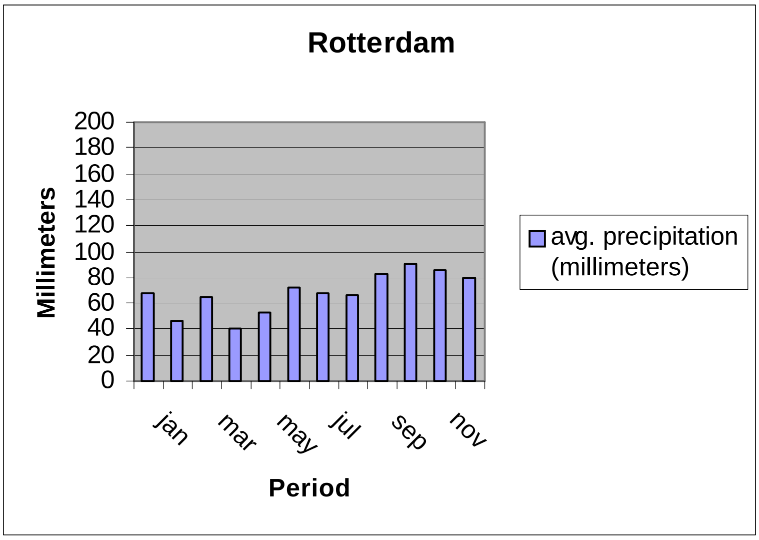

Figure 21: Precipitation characteristics Rotterdam

Source: Royal Netherlands Meteorological Institute

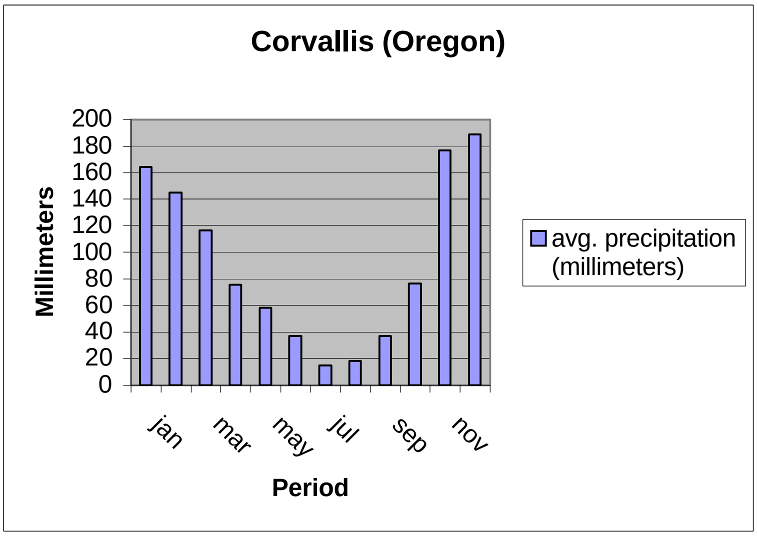

Figure 22: Precipitation characteristics Corvallis

Source: The Weather Channel (minimum period of record: 30 years)

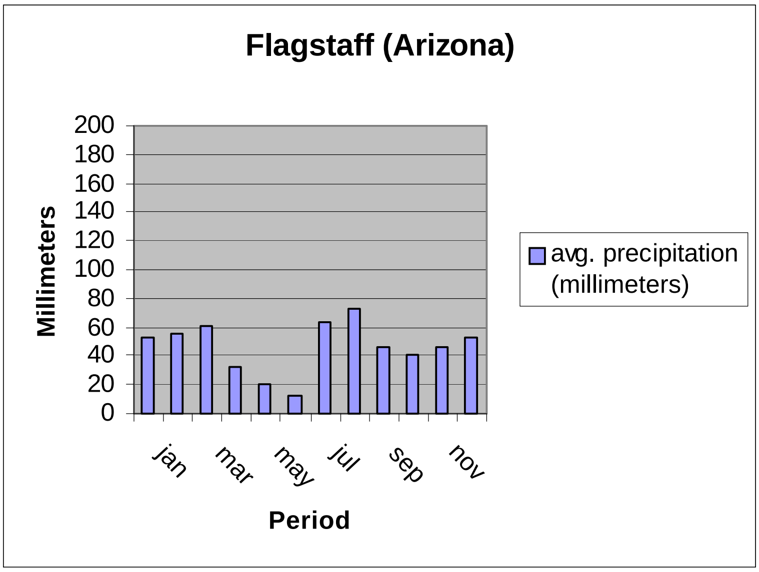

Figure 23: Precipitation characteristics Flagstaff

Source: USA today

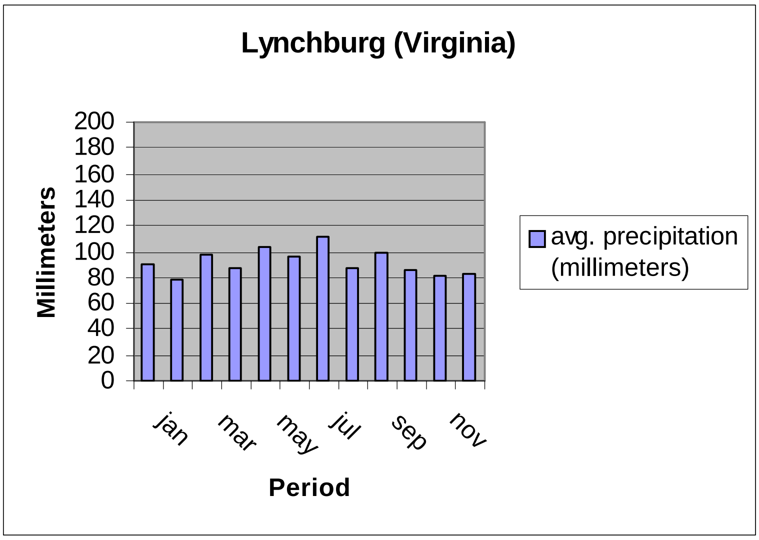

Figure 24: Precipitation characteristics Lynchburg

Source: The Weather Channel (minimum period of record: 30 years)